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REMOVAL DESIGN INVESTIGATION SAMPLING AND ANALYSIS PLAN

FOR

OPERABLE UNIT 7 OF THE LIBBY ASBESTOS SUPERFUND SITE

April 16, 2010

Prepared for:

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY
Remediation Division
P.O. Box 200901
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Contract Number 407026
Contract Task Order Number 63

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Additional copies of the Operable Unit 7 removal design investigation documents can be made available to the above-listed persons for further distribution within their respective agencies.

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ACRONYMS AND ABBREVIATIONS

AHERA	Asbestos Hazard Emergency Response Act
AR	Aspect ratio
ASTM	ASTM International (formerly the American Society for Testing and Materials)
CDM	Camp, Dresser & McKee
CFR	Code of Federal Regulations
cm^2	Square centimeters
COC	Chain of custody
CPR	Cardiopulmonary resuscitation
CUA	Common use area
DEQ	Montana Department of Environmental Quality
DQO	Data quality objective
EDD	Electronic data deliverable
EPA	U.S. Environmental Protection Agency
ERS	Environmental Resource Specialist
ESAT	Environmental Services Assistant Team
GPS	Global positioning system
HASP	Health and safety plan
HVAC	Heating, ventilation, and air conditioning
ID	Identification
IDW	Investigation-derived waste
ISO	International Organization for Standardization
ISTM	International Society for Testing Materials
L	Length
LA	Libby Amphibole
LUA	Limited-use area
NIOSH	National Institute for Occupational Safety and Health
NUA	Non-use area
OSHA	Occupational Safety and Health Administration
OU	Operable unit
PDA	Portable digital assistant
PDF	Personal data format
PLM	Polarized light microscopy
PLM-VE	Polarized light microscopy – visual estimation
PPE	Personal protective equipment
QAPP	Quality assurance project plan
QC	Quality control

ACRONYMS AND ABBREVIATIONS
(Continued)

RDI	Removal Design Investigation
s/cm^2	Structures per square centimeter
SAP	Sampling and analysis plan
SOP	Standard operating procedure
SRC	Syracuse Research Corporation
SUA	Specific-use area
TAPE	Troy Asbestos Property Evaluation
USACE	US Army Corps of Engineers
VCI	Vermiculite-containing insulation
VV	Visible vermiculite
WP	Work Plan

1.0 INTRODUCTION

Tetra Tech received Task Order 63 from the Montana Department of Environmental Quality, Remediation Division (DEQ), under DEQ Contract No. 407026. The purpose of this task order is to provide administrative, technical, field, sampling, and oversight support to the United States Army Corp of Engineers (USACE) during removal activities in Operable Unit 7 (OU7) of the Libby Asbestos Superfund Site. The United States Environmental Protection Agency (EPA) is the lead agency for the Libby Asbestos Superfund Site. DEQ is the lead agency for OU7 through a cooperative agreement with EPA.

This document serves as the removal design investigation (RDI) sampling and analysis plan (SAP) for OU7 and will guide pre-removal design activities that will be performed by EPA, DEQ, USACE, or their contractors. The document describes investigation and sampling activities that will be implemented to fill data gaps needed to design removal activities at properties within OU7. Because of similar tasks being conducted concurrently in Operable Unit 4 (OU4) of the Libby Asbestos Superfund Site, this document is a companion to the OU4 Work Plan prepared by Camp Dresser & McKee (Camp, Dresser, & McKee [CDM] 2010).

This SAP includes all required elements for both a field sampling plan and a quality assurance project plan (QAPP), and was developed in accordance with EPA guidance documents *Environmental Protection Agency Requirements for Quality Assurance Project Pl*ans, EPA QA/R-5 (EPA 2001) and *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G4 (EPA 2006).

The purpose of this SAP is to describe the sampling objectives, data quality objectives (DQO), locations, and measurement methods to support removal designs for properties within OU7.

The SAP is organized as follows:

Section 1 – Introduction
Section 2 – Project Background
Section 3 – Data Quality Objectives
Section 4 – Sampling Program
Section 5 – Laboratory Operations
Section 6 – Data Management
Section 7 – Quality Assurance/Quality Control Procedures
Section 8 – References

Tables and figures in this document follow the first reference in the text. Appendix A contains the site-specific health and safety plan (HASP) and HASP Addendum, Appendix B contains field forms and laboratory forms anticipated for use during the RDI, and Appendix C contains standard operating procedures (SOP) that will be used during the RDI.

1.1 REMOVAL DESIGN INVESTIGATION OBJECTIVES

The primary objective of the OU7 RDI is to collect the additional data necessary to design removal activities at properties within OU7, where Troy Asbestos Property Evaluation (TAPE) investigations have identified the presence of Libby Amphibole (LA) and/or LA source materials.

1.2 PROJECT SCHEDULE AND DELIVERABLES

RDI activities are expected to begin in April 2010 and are anticipated to be completed by September 31, 2010. Approximately 110 properties in OU7 have been identified as candidates for removal actions.

2.0 PROJECT BACKGROUND

From the 1920s until 1990, an active vermiculite mine and associated processing operations were located in Libby, Montana. While it was in operation, the mine may have produced 80 percent of the world's supply of vermiculite (EPA 2005). The processed and exfoliated vermiculite was primarily used for insulation in buildings and as a soil amendment. The Libby vermiculite deposit includes amphibole asbestos. For decades, the processing of vermiculite ore and generation and disposal of waste materials resulted in the widespread presence of amphibole asbestos throughout the Libby community. In 1999, EPA Region 8 dispatched an emergency response team to investigate media reports of abundant amphibole asbestos and high rates of asbestos-related disease in Libby. Subsequent environmental investigations have found asbestos throughout many areas in and around Libby that include a form of amphibole asbestos known as LA.

2.1 SITE LOCATION

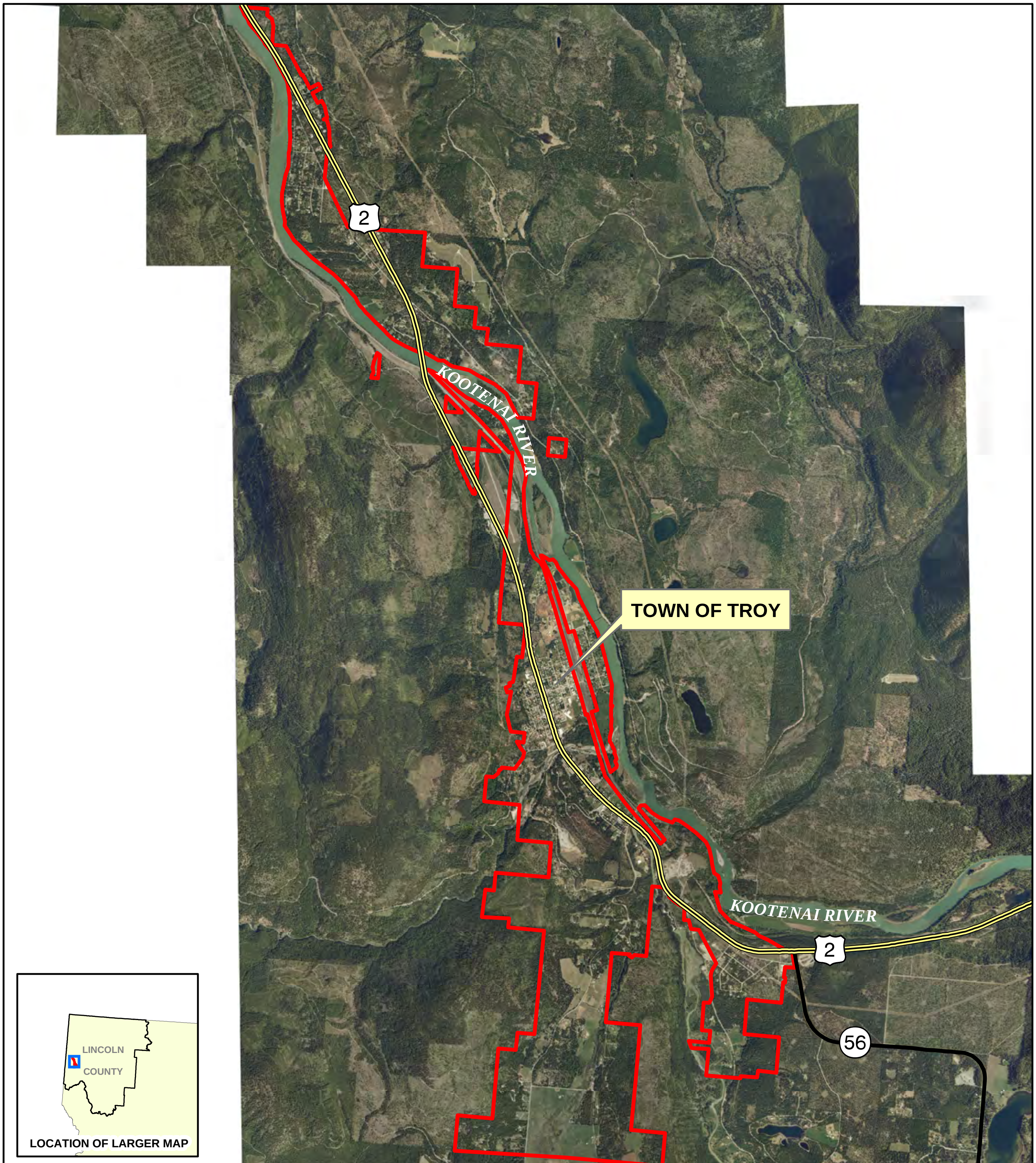
Troy, Montana is located 18 miles northwest of Libby, Montana and has been designated as OU7 of the Libby Asbestos Superfund Site. OU7 is located within the Kootenai River valley at an elevation ranging from 1,850 feet above mean sea level at the northern end of OU7 to 2,500 feet above mean sea level on the mountain slopes surrounding the valley. OU7 is approximately 8 miles long and up to 1.8 miles wide. Topography of OU7 consists of relatively flat river valley terraces on both sides of the gently graded Kootenai River. Several tributaries flow into the Kootenai River along the 8-mile stretch of the river contained within the OU.

The OU7 boundary (Figure 2-1) was selected to ensure that investigations captured most of the older homes in and around Troy that are more likely to contain LA or LA source materials.

2.2 SITE HISTORY

Since the nature of LA and associated exposure pathways in OU7 are similar to those observed in Libby, and the vermiculite insulation found in Troy is similar in both morphology and mineralogy to the insulation found in Libby, a systematic screening of interiors of Troy area residences, public areas, schools, and businesses was conducted to gather information to determine how many Troy area properties have LA present. This systematic screening is referred to as the TAPE inspections.

Some of the vermiculite mine workers lived in Troy and commuted to the mine in Libby to work each day. The mine workers were exposed to asbestos-containing materials at the mine and processing facilities, and they transported asbestos-containing dust to their homes on clothes and equipment.



Legend

OPERABLE UNIT 7 BOUNDARY

0 1 Miles

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TETRA TECH EM, INC

LIBBY ASBESTOS SUPERFUND SITE

FIGURE 2-1
OPERABLE UNIT 7

GIS map by DWH - TTEMI-HE
FIG2-1_OU7_BOUNDARY_032510.mxd

Residents of Troy also traveled to Libby for everyday activities such as shopping, working (other than at the mine), and attending school sporting events. They likely came into contact with LA in Libby during these frequent visits. In addition, the asbestos-containing vermiculite ore and waste materials in varying forms may have been used for amending soils (as fill or as a conditioner), building materials (plaster, concrete, or chinking amendment), wood burning, spilled or placed on transportation corridors, and for insulating buildings in and around Troy.

2.3 OCCURRENCE OF LIBBY AMPHIBOLE

Typically, the LA found in southern Lincoln County comes from one, or some combination of, primary sources outside of OU7 including vermiculite mining waste, vermiculite ore, vermiculite processing waste, bulk residuals from vermiculite processing, LA-containing rock, or LA-containing vermiculite insulation. Although there are no major sources of LA within OU7, residential use of vermiculite from the Libby mine, primarily as building insulation and as a soil amendment, was common. In some cases, vermiculite insulation has been found in interior and exterior walls due to sifting from the attic. In rare cases, vermiculite has been found as an additive in building materials such as plaster, mortar, and concrete.

The LA-containing soil is generally due to vermiculite that was used as a soil amendment in flowerbeds and gardens, for leveling of low spots, and for backfilling of utilities.

2.4 SUMMARY OF THE TAPE INSPECTIONS

The TAPE inspections were initiated in 2007 to characterize the nature and extent of LA-containing materials present in interior and exterior locations of properties within the OU7 boundary. To date, this has entailed a systematic screening of approximately 1,280 Troy area residences, public areas, schools, and businesses in order to gather sufficient information to determine how many Troy area properties meet the removal action criteria for LA.

As a result of the TAPE inspections, a total of 110 properties were identified for removal actions. Parcels selected for removal actions were categorized by the areas where LA or LA source materials were identified, including: interior areas (i.e. attics), exterior soils, or a combination of both interior and exterior areas. Removal selection criteria were based on the following: 1) analytical results, 2) visual observations, 3) historical information such as confirmed transport of vermiculite originating from Libby source areas, and 4) any other pertinent information specific to a property.

3.0 DATA QUALITY OBJECTIVES

The DQO process is a series of planning steps designed to ensure that the type, quantity, and quality of environmental data used in decision-making are appropriate for the intended purpose. The DQOs presented in this section were developed in accordance with EPA guidance (EPA 2006).

DQOs help to clarify the study objectives, define the most appropriate data to collect and the conditions under which to collect the data, and specify tolerable limits on decision errors that will be used as the basis for establishing the quantity and quality of data needed to support decision-making. The DQOs are used to develop a scientific and resource-effective design for data collection.

The DQO process consists of seven steps; output from each step influences the choices that will be made later in the process. These steps include:

1. State the problem
2. Identify the decision
3. Identify the inputs to the decision
4. Define the study boundaries
5. Develop decision rules
6. Specify tolerable limits on decision errors
7. Optimize the investigation design

3.1 STEP 1 – STATE THE PROBLEM

The purpose of this step is to describe the problem to be addressed. Although the OU7 TAPE inspections have been largely completed and the parcels requiring removal actions have been identified, data gaps still remain and prevent the development of detailed removal designs. These data gaps need to be addressed in order to design removals at the properties identified for removals. The RDI is designed to fill these data gaps by further delineating the extent of LA on each property. This SAP describes the inspection and sampling procedures that will be used to collect data of sufficient quality and representativeness to design the removal actions.

3.2 STEP 2 – IDENTIFY THE DECISION

This step identifies the questions the RDI is designed to answer and what actions may result. The principal questions and possible alternative actions are in Table 3-1 below.

TABLE 3-1

PRINCIPAL STUDY QUESTIONS AND ALTERNATIVE ACTIONS

<table>
<tr><th>Response Item Evaluated</th><th>Principal Study Question</th><th>Alternative Actions</th></tr>
<tr><td rowspan="4">Quantify characteristics of identified LA or vermiculite containing materials where data gaps have been identified.</td><td rowspan="2">What is extent of vermiculite containing material present in buildings?</td><td>▪ Sketch and document location of living space with LA-contaminated indoor dust for removal planning
▪ Take no action</td></tr>
<tr><td>▪ Sketch and document location of visible vermiculite for removal planning
▪ Take no action</td></tr>
<tr><td>What is extent of visible vermiculite in surface soils?</td><td>▪ Where data gaps exist, sketch and document location and extent of vermiculite-containing soil for removal planning
▪ Take no action</td></tr>
<tr><td>What is the extent of LA, as detected by analytical methods, in surface soils?</td><td>▪ Where data gaps exist based on analytical results, collect additional samples and then sketch and document location and extent of LA in soil for removal planning
▪ Take no action</td></tr>
</table>

Notes:

LA Libby Amphibole

3.3 STEP 3 – IDENTIFY THE INPUTS TO THE DECISION

The purpose of this step is to identify the information and measurements that need to be obtained to resolve the decision statements. The information needed to resolve the principal study questions are summarized in Table 3-2.

3.4 STEP 4 – DEFINE THE BOUNDARIES OF THE STUDY

This step specifies the spatial and temporal boundaries of the RDI.

3.4.1 Spatial Bounds

The horizontal boundaries of the RDI are the boundaries of each of the 110 properties identified for removal. The vertical boundaries extend from the highest point at a property, approximately two stories, to the depth of soil samples collected, approximately 6 inches below ground surface.

3.4.2 Temporal Bounds

For each property, the temporal boundaries of this investigation include the time from when it was determined that LA or LA source materials exist on the property to when the RDI has been completed.

TABLE 3-2

SUMMARY OF INPUTS TO RESOLVE STUDY QUESTIONS AND USE OF INFORMATION ACQUIRED FROM INPUTS

Principal Study Question	Input to Resolve Question	Use of Input to Resolve Question
Is vermiculite insulation present in property buildings?	Visual Inspection	For each property undergoing an RDI, a visual inspection will be performed within each building on the property. The results of the visual inspection will be used to determine the extent of LA source materials for removal planning.
Is LA detected in friable building materials (e.g., plaster) that contain vermiculite additives?	Bulk Material Samples	For each property undergoing an RDI, bulk material samples will be collected from friable building materials that contain vermiculite. The results of the bulk material samples will be used to determine if LA is present in the building materials at individual properties for removal planning.
Is LA detected at concentrations greater than or equal to 5,000 s/cm^2 in indoor dust from any one previously collected dust samples from individual properties?	Dust Samples	For each property where dust samples were collected during TAPE investigations, analytical results will be reviewed to determine if LA is present in indoor dust at individual properties for removal planning. Dust samples will not be collected as part of this investigation.
Is vermiculite and/or LA visible in surface soils?	Visual Inspection	For each property undergoing an RDI, semi-quantitative visual estimation inspections for vermiculite will be performed on surface soils to determine the extent of vermiculite for removal planning.
What is the extent of LA in surface soils?	Soil Samples	For each property undergoing an RDI, additional surface soil samples may be collected from use areas (e.g., specific-use areas, common-use areas, limited-use areas, etc.) to determine the extent of LA for removal planning.

Notes:
LA Libby Amphibole
RDI Removal design investigation
s/cm^2 Structures per square centimeter

3.5 STEP 5 – DEVELOP DECISION RULES

This step describes the method to be used to determine whether the data collected indicate acceptance and the resulting decision applied when acceptance is not obtained. The principal study questions, inputs to resolve study questions, action levels, and decision rules are summarized in Table 3-3.

3.6 STEP 6 – SPECIFY TOLERABLE LIMITS ON DECISION ERRORS

The tolerable limits on decision errors, used to establish performance goals for the data collection design, are specified in this step.

TABLE 3-3
DECISION RULES

Principal Study Question	Input to Resolve Question	Input Requirements	Action Level	Decision Rule
What is extent of vermiculite insulation present in buildings?	Visual Inspection	Delineation details including location, volume and access for removal.	Presence of vermiculite	Vermiculite insulation documented will be measured and sketched for subsequent removal action.
What is extent of LA-containing friable building materials (e.g., plaster) that contain vermiculite additives?	Bulk Material Samples	Analysis: PLM by NIOSH 9002 Reported Result: % LA AS: Method defined as 1%, but qualitative estimates of LA present below 1% reported as less than 1% or ND	Any detectable LA	If any LA is detected in bulk material samples, the building material(s) that the bulk sample represents will be sketched and documented for subsequent removal action.
What is the extent of LA in surface soils?	Visual Inspection Soil Samples	CDM-LIBBY-06 for Visual Analysis and Laboratory Analysis by PLM-VE and PLM-Grav with project-specific modifications Reported Result: % LA AS: 0.2% LA	Detectable quantities of visible vermiculite as defined in CDM-LIBBY-06 Any detectable LA in laboratory samples	If vermiculite is observed in surface soils, the location will be sketched/documented for sampling and potential subsequent removal action. If any detectable levels of LA are found in surface soil samples, the location will be sketched/documented for subsequent removal action and confirmation soil samples collected.

Notes:
AS Analytical sensitivity
LA Libby Amphibole
ND Nondetect
NIOSH National Institute for Occupational Safety and Health
% Percent
PLM Polarized light microscopys/cm^2 Structures per square centimeter

Specific to performing the RDI, two types of decision errors are possible:

- A Type I (false negative) decision error would occur if a risk manager decides that an inspection/sample does not contain vermiculite/LA above a level of concern, when in fact it is of concern.
- A Type II (false positive) decision error would occur if a risk manager decides that an inspection/sample does contain vermiculite/levels of LA above a level of concern, when in fact it does not.

DEQ is most concerned about avoiding Type I errors, since an error of this type may leave humans exposed to unacceptable levels of LA.

DEQ is also concerned with the probability of making Type II (false positive) decision errors. Although this type of decision error does not result in unacceptable human exposure, it may result in unnecessary expenditure of resources.

For the purpose of completing all seven steps of the DQO process, the null hypotheses and consequences of making an incorrect decision are summarized in Table 3-4. However, the gray region and tolerable limits on decision errors are not proposed because they are not applicable in this case.

3.7 STEP 7 – OPTIMIZE THE INVESTIGATION DESIGN

This step identifies a resource-effective data collection design for generating data that are expected to satisfy the DQOs. The data collection design is described in detail in the remaining sections of this SAP and other site documents referenced in Section 4.

TABLE 3-4
LIMITS ON DECISION ERRORS

Principal Study Question	Null Hypothesis	Type I Error Will Result in:	Type II Error Will Result in:
What is extent of vermiculite insulation present in buildings?	Vermiculite insulation is present in buildings.	Not collecting the correct removal data needed in the RDI. This would result in not completing removal of interior vermiculite successfully and in turn, an increased risk to human health.	Determining that buildings contain vermiculite insulation when actually they do not, overestimating the amount of vermiculite insulation present, or incorrectly reporting the location of vermiculite insulation. This would result in unnecessarily performing a removal action or inefficiency during removal that adds to removal costs.
What is extent of LA-containing friable building materials (e.g., plaster) that contain vermiculite additives?	Friable building materials contain vermiculite with LA.	Determining that friable building materials that contain vermiculite do not contain LA when they actually do. The LA-containing building material(s) would not be included in the removal action and in turn, an increased risk to human health.	Determining that friable building materials that contain vermiculite contain LA when actually they do not, overestimating the amount of friable building materials, or incorrectly reporting the location of the friable building materials. This would result in unnecessarily including the building materials in the removal action or inefficiency during removal and adds unnecessary costs to the removal.
What is the extent of LA in surface soils?	Surface soils contain LA.	Determining that surface soils do not contain LA when they actually do. The LA-containing soils would not be included in the removal action and in turn, an increased risk to human health.	Determining that surface soils contain LA when actually they do not, overestimating the amount of LA-containing soils present, or incorrectly reporting the location of LA-containing soils. This would result in unnecessarily including exterior excavation to the removal action, overestimating the amount of LA-containing soils present, or incorrectly reporting the location of LA-containing soils and adds unnecessary costs or inefficiency to the and removal.

Notes:
LA Libby Amphibole
RDI Removal design investigation

4.0 SAMPLING PROGRAM

This section summarizes field activities that will be performed in support of the RDI in OU7. This section also provides brief summaries of SOPs, including project-specific modifications where applicable and project-specific details not discussed in the SOPs. As previously mentioned, the RDI is designed to determine the extent of LA for subsequent removal actions.

The site-specific HASP and addendum (Appendix A) should be consulted to determine health and safety protocols for performing RDI work. Field forms and project-specific SOPs are included in Appendices B and C, respectively.

All sampling activities will be performed in accordance with this SAP. The SOPs and project-specific procedures to be employed are:

- 2007 TAPE Work Plan (WP) for OU7
- 2009 Tetra Tech Aggressive Attic Entry SOP
- CDM-LIBBY-05, Revision 3, Soil Sample Collection at Residential and Commercial Properties
- CDM-LIBBY-06, Revision 1, Semi-Quantitative Visual Estimation of Vermiculite in Soils at Residential and Commercial Properties

The following sections summarize field activities that will be performed during the implementation of the sampling investigation efforts described in this SAP.

Analytical methods for all samples collected in accordance with this SAP are discussed in detail in Section 5.

4.1 PRE-SAMPLING ACTIVITIES

Prior to beginning of field activities, a field kickoff meeting will be conducted, required training will be performed, and appropriate site specific instructions will be provided to the field team.

4.1.1 Field Planning and Required Equipment and Supplies

Before field crews mobilize to perform the RDI, the contractors will prepare detailed property maps that identify individual OU7 properties. The RDI activities schedule will be refined as Tetra Tech schedules the inspections at dates and times convenient to the property owners.

The field manager will conduct an inventory of project-procured equipment and supplies prior to field work. Any additional required equipment or supplies will be procured. The following equipment is required for sampling activities conducted under this SAP:

- Field logbooks
- Indelible ink pens
- Digital camera with memory card, as appropriate
- Sample paperwork and sample tags/labels
- Custody seals
- Plastic zip-top bags
- Soil sampling equipment
- PPE as required by site-specific HASP (Appendix A)
- Geo XT PDA
- Cordless drill and scope
- Ladder
- Standard hand tools (screwdrivers, hammer, pry-bar, etc.)
- Measuring wheel/tape

4.2 REMOVAL DESIGN INVESTIGATION

This section describes the sampling methods and procedures that will be used to complete RDIs. RDIs are performed to capture additional information on a property to support removal activities. RDIs are completed at properties that have undergone a TAPE inspection and display one or more removal triggers.

The following is a summary of field activities that will be performed by DEQ, USACE, or their contractors during the RDI:

- Property selection and communication
- Land survey
- Scheduling investigations
- Review of previously collected data
- Interior inspection
- Exterior inspection

4.2.1 Property Selection and Communication

The EPA has established criteria for the removal of vermiculite attic insulation and/or soil contaminated with LA asbestos fibers from properties in OU4. A similar set of criteria have been established for OU7, but have been adjusted to reflect the results of the TAPE inspection results. The criteria for OU7 are: 1) the visual observation of vermiculite insulation in the attic or living space; and 2) LA asbestos fibers present in soil samples at a concentration greater than 1%. In addition, a combination of the information gathered during the interview, analytical results from soil sampling, and the results of visual property inspection will determine the need for further exterior action at a property.

The nature of the removal action will be considered during the initial removal action scheduling. Exterior removal actions will involve significantly more time than interior actions. Properties slated for removal actions will be clustered geographically to maximize the efficiency of the removal.

DEQ has determined the parcels targeted for removal. The property owner will be contacted to confirm willingness to participate. Information provided to the property owner at that time will include general details on the investigation and removal process, and a tentative time-frame for investigation and potential removal activities. The property will be placed in the queue for continued investigation activities once the owner has confirmed willingness to participate in the entire process. The presence of children at the property will expedite the property on the removal schedule, if possible. If the property owner is unwilling to participate with the complete investigation and removal process within the stipulated time-frame, the property will be reconsidered for removal at a later date.

4.2.2 Land Survey

A land survey will be conducted at each property that requires an exterior removal action and has a property owner willing to participate in the process. Land surveys will include property boundaries to determine the limits of the property on which the removal is being conducted. Land surveys will also include major physical and geographic features of the property (e.g., structures/buildings, trees, individual land use areas). The survey contractor will be a registered and licensed land surveyor in the State of Montana.

A land survey will be requested once a property is identified as requiring an exterior removal action. When available, a hard copy of the survey will be used by the RDI team to mark soil sample locations and results, locations of visible vermiculite, and additional inspection information. When land surveys are not available, site-specific sketches will be completed on aerial photographs, scaled graph paper, or equivalent. Specific information to be captured by the RDI team is discussed in the following sections.

4.2.3 Scheduling Removal Design Investigations

The property owner will be notified of the need for RDI activities on their property. The RDI will be scheduled for a time that is convenient for the property owner or tenant. If an interior removal has been identified for the property, the property owner or tenant will need to be present to allow access to the interior of each building on the property. If only exterior removal actions have been identified for the property, the property owner or tenant may or may not need to be present.

4.2.4 Previously Collected Data

Prior to arriving at a property, the RDI team will review TAPE collected data in order to identify data gaps. All TAPE data and any data collected during an Environmental Resource Specialists (ERS) initial response will be reviewed. A complete set of property-specific data is maintained in the project file folder at the DEQ Troy Information Center located in Troy, Montana office. All property data (i.e., scanned data archive, Scribe database, and ERS initial assessment form, etc.) will be reviewed to identify data gaps for the RDI.

4.2.5 Interior Detailed Inspection

Interior detailed inspections will be performed when previous investigation findings indicate either LA is present or unknown within buildings (e.g., house, garage, shed, barn, etc.) at the property. Interior inspection activities may include:

- Attic inspection
- Living space assessment and wall inspection
- Understructure inspection
- Bulk material samples, if needed
- Interior soil samples, if needed
- Interior inspection documentation

Interior inspections will be performed to determine the location and extent of LA-containing materials within a building. Information will also be collected regarding the general construction and condition of the building and access to LA-containing materials. Interior inspections will include attic spaces, living spaces, and understructures (e.g., basement, cellar, crawl space). Interior details will be recorded on the PDA, in the logbook, and on the associated sketch(s) as discussed in Section 4.2.5.6.

4.2.5.1 Attic Inspection

Attic inspections will be completed in buildings where previous inspections indicated the presence of vermiculite insulation, or if the presence/absence of vermiculite was not confirmed during previous investigations. Attic inspections will be limited to confirming the presence/absence of vermiculite insulation and collecting sufficient details to support removal activities. All attic spaces will be inspected until either vermiculite insulation is confirmed, or until the entire attic has been inspected and no vermiculite insulation is present. Once vermiculite insulation is confirmed in an attic space, all details for the attic will be collected from that location and the inspection will cease.

Attic details will be recorded on the PDA, in the logbook, and on the associated sketch(s) as discussed in Section 4.2.5.6.

4.2.5.2 Living Space Assessment and Wall Inspection

Interior living spaces will be further inspected to obtain data gaps identified regarding presence and nature of vermiculite materials. Vermiculite may appear in living spaces as insulation that is leaking from the attic or walls, or as an additive in building materials. Living space assessments will include inspecting all walls, all ceiling and wall penetrations (plumbing, heating, ventilation and air conditioning [HVAC] systems, electrical fixtures, cracks, gaps, etc.), and plaster/mortar materials. If vermiculite additives are identified within building materials, bulk material samples may be required as discussed in Section 4.2.5.4.

Based on previous investigation findings, small amounts of vermiculite insulation are likely to be present within wall cavities of buildings that have vermiculite attic insulation. If vermiculite insulation is observed within the attic of a building, it will be assumed that the walls below those attic sections will contain some amount of vermiculite. This will be noted within the interior inspection documentation as detailed in Section 4.2.5.6.

Living space details will be recorded on the PDA, in the logbook, and on the associated sketch(s) as discussed in Section 4.2.5.6.

4.2.5.3 Understructure Inspection

Building understructures will be inspected to determine if vermiculite materials are present. Vermiculite may appear in understructures as insulation that is leaking from the attic or walls, as additives in building materials, or as vermiculite in soil floors. Understructure inspections will include inspecting all ceiling and wall penetrations (plumbing, HVAC, electrical, cracks, gaps, fixtures, etc.), plaster/mortar materials, and inspecting soil floors. If the building understructure has a soil floor, a visual inspection will be completed per Section 4.2.6.1 of this SAP. If vermiculite is not observed within the soil floor, soil samples will be collected as discussed in Section 4.2.5.5.

Understructure details will be recorded on the PDA, in the logbook, and on the associated sketch(s) as discussed in Section 4.2.5.6. In addition to general details, the RDI team will make a determination as to the frequency the understructure is used. Understructures will be categorized as frequently used, infrequently used, or a combination of the two (for separate areas). Infrequently used understructures will include areas that are accessed on an irregular basis only, generally for maintenance purposes only.

4.2.5.4 Bulk Material Samples

Bulk material samples will be collected when vermiculite additives are identified within a building material, and only if that material is friable (i.e., easily pulverized by hand). Bulk material samples will be collected in compliance with 40 CFR 763.86.

4.2.5.5 Interior Soil Samples

Soil samples will be collected from inside a structure only if significant soil areas are present (e.g., soil floor) where vermiculite was not observed during visual inspection and where data gaps exist (e.g. previous limited access). Individual flower pots/planters will not be sampled. Soil samples will be collected in accordance with Section 4.2.6.2.1.

4.2.5.6 Interior Inspection Documentation

Details for each building/structure inspected will be recorded in the PDA and logbook. Attic, living space, and understructure sketches will be completed as appropriate. Sketches will include the details indicated in Table 4-1. Sketches will only be prepared for the levels/floors of the structure where LA source materials are observed and/or where samples are collected.

4.2.6 Exterior Detailed Inspection

Exterior detailed inspections will be performed at properties where previously collected data indicates the presence of a current removal trigger. Exterior inspections are performed to further define the location and extent of LA-containing material and to ensure that the entire property has been characterized. Exterior inspection information will be recorded in the logbook, PDA, and associated sketches.

Exterior inspection activities include:

- Visual inspection
- Soil sampling
- Exterior inspection documentation

4.2.6.1 Visual Inspection

Visual inspection of exterior soils will be completed in accordance with CDM-LIBBY-06. The number of point inspections to be completed per use area is defined in Table 4-2.

4.2.6.2 Soil Sampling

Soil samples were collected during previous investigation/screening activities to determine the presence/absence of LA within soil throughout varying sizes of use areas. Delineation samples will be collected to further define the extent of LA in soil throughout the property.

TABLE 4-1

PROPERTY SKETCH DETAILS

Interior Inspection Sketch Details		
Attic	**Living Space**	**Understructure**
o Plan view/layout – including dimensions o Types of insulation o Depth of insulations o Attic accesses - location and size o Head space – structure cross-section o Hazards (in attic and near access) o Obstacles o Joist – size and spacing o Flooring (above and below joist)	o Floor plan/layout o Location of visible vermiculite leaking from walls and attic, etc.	o Soil samples – locations and results o Visual inspection results o Floor types – soil versus solid flooring

Exterior Inspection Sketch Details	
Analytical Sketch	**Visual Inspection Sketch**
o Soil samples – locations and results o Personal items within areas requiring removal o Fence lines o Underground utilities – if known o Overhead utilities – if not shown on survey o BD Numbers for all structures on the property	o Visual inspection results – each point inspection labeled as (N)=None, (L)=Low, (I)=Intermediate, or (H)=High level of visible vermiculite o Personal items within areas requiring removal o Fence lines o Underground utilities – if known o Overhead utilities – if not shown on survey o BD Numbers for all structures on the property

BD – Building

TABLE 4-2
VISUAL INSPECTION AND SOIL SAMPLING PROTOCOL

Area Type[1]	Visual Inspection Protocol[2]	Soil Sampling Protocol[3]
SUA (Flowerbed, Garden, Play Area, etc.)	1 PI/100 ft^2	1 sample/1,000 ft^2
Driveway (SUA)	1 PI/200 ft^2	1 sample/6,000 ft^2
CUA (Yard, etc)	1 PI/100 ft^2	1 sample/3,000 ft^2
LUA (Field, Pasture, etc.)	1 PI/500 ft^2	1 sample/15,000 ft^2
ISA (Shed, Carport, Garage, etc.)	1 PI/100 ft^2	1 sample per use area
Crawlspace (ISA)	1 PI /100 ft^2	1 sample per use area
NUA (Wooded Area, etc.)	No Inspection	No Sampling

[1]Mulitple SUAs of the same type within the same general area may be combined to form one sample area. Examples include gardens along the drip line of the house, or multiple raised flower beds within a CUA.
[2]A minimum of 5 points will be inspected per use area regardless of size.
[3]All soil samples are 30-point composites. Areas where vermiculite is observed will also be sampled.

SUA – Specific Use Area
CUA – Common Use Area
LUA – Limited Use Are
NUA – Non Use Area
ISA – Interior Surface Area
PI – Point Inspection
ft^2 – square feet

4.2.6.2.1 Sample Collection

The frequency of RDI soil samples will be collected in accordance with Table 4-2, which defines the maximum area per soil sample. The RDI soil samples will be collected following the procedures described in the TAPE Work Plan (Tetra Tech 2007). Thirty soil aliquots will be placed into a stainless steel bowl, homogenized, and placed in a re-closable plastic bag.

4.2.6.3 Exterior Inspection Documentation

The PDA, logbook, and associated sketch(es) will be completed for each property inspected as part of this SAP. Sample information and visual inspection results will be recorded on two (2) separate property sketches. If available, a property survey will be utilized as the baseline for these sketches. If a property survey is not available, aerial photos, scaled graph paper, or an equivalent will be used. Sample information and visual inspection results may be combined on one sketch if quality and clarity can be maintained. Sketches will include the details indicated in Table 4-1.

4.3 FIELD QUALITY CONTROL SAMPLES

Field quality control (QC) samples are currently not required for bulk materials due to the homogenous nature of the material being sampled. Field QC samples associated with soil samples include equipment blanks and field duplicate samples. These are described below and summarized in Table 4-3.

TABLE 4-3
FIELD QUALITY CONTROL SAMPLES

Sample Type	Associated QC Sample	Collection Frequency	Analysis Frequency	Analysis Request	Acceptance Criteria
Soil	field duplicate	1 per 20 field samples	100%	PLM-VE/PLM-Grav	<30% RPD
Bulk Material	N/A	N/A	N/A	N/A	N/A

Notes:

PLM-VE Polarized light microscopy visual area estimation method
PLM-grav Polarized light microscopy gravimetric estimation method
RPD Relative percent difference
N/A Not applicable

4.3.1 Equipment Blanks

Equipment blanks are currently not required by EPA for soil sampling at the Site because: 1) detection levels for LA using current polarized light microscopy (PLM) analytical methods are not low enough to capture concentrations that would be expected in equipment blanks; and 2) the frequency of detection for LA in historically-collected project equipment blanks is extremely low.

4.3.2 Field Duplicate Samples

Field duplicate samples for RDI soil sampling activities will be collected at a rate of 1 per 20 field samples collected. Field duplicate samples will be collected from areas that are being sampled during one of the investigation activities discussed in the previous sections. However, individual composite points for the duplicate sample will be collected from different locations (within the same use area) than the original sample. Field duplicate samples will be collected in accordance with the TAPE WP.

4.4 GENERAL PROCESSES

This section describes the general field processes that will be used to support the sampling described in this SAP and includes references to the general and project-specific SOPs where applicable.

4.4.1 Equipment Decontamination

Stainless steel scoops and bowls will be used for soil sampling; therefore, decontamination of the equipment that is in contact with the soil will be necessary. If a small metal shovel is required to assist with sampling to 6 inches in hard, compacted soils, the shovel will be thoroughly cleaned and decontaminated. Decontamination will occur in the location where the sample was collected and will include spraying the equipment with distilled water followed by drying with paper towels. The water will be allowed to fall on the ground surface within the area just sampled and the paper towels will be placed in a labeled asbestos waste bag.

Visible soil on hands or clothing will be removed by washing with soap and water. Additional personnel decontamination procedures, including requirements for decontamination zones, are described in Section 10.1 of the TAPE HASP (Appendix A). PPE will include disposable gloves, disposable protective outerwear, work boots, disposable boot covers, and respirators. The respirators will be cleaned and decontaminated as discussed in Section 10.2.1 of the TAPE HASP (Appendix A).

4.4.2 Investigation-Derived Waste

Investigation-derived waste will include used wet wipes, wet paper towels, and disposable gloves, used respirator cartridges, used plastic tubing, disposable protective outerwear, plastic floor coverings, and other minimal waste. It is possible, but not likely, that these investigation-derived waste materials may contain some asbestos. Therefore, all investigation-derived waste will be double-bagged in appropriate asbestos bags, labeled with asbestos labels, and stored in an approved containment area at the DEQ Troy Information Center until it can be properly disposed of at an approved landfill. Non-sampling waste generated by the RDI field teams, such as food containers and waste paper, will be separately bagged and properly disposed of as solid waste.

4.4.3 Recordkeeping and Chain of Custody

At the end of each day, or more often if required, the RDI field teams will return to the DEQ Troy Information Center to download the PDA and transfer the soil, QC samples, and copies of the appropriate logbook pages to the field sample coordinator (or the coordinator's designee). Digital photographs will also be downloaded daily to a computer at the DEQ Troy Information Center. Photographs will be labeled and downloaded into the Troy project Scribe database based on property, use area, and building identification (ID) numbers. Individual photographs will not be routinely printed from the DEQ Troy Information Center.

An individual file (both paper and electronic) will be maintained for each property inspected. Originals of all field forms will be kept in each individual property file in the DEQ Troy Information Center for the duration of the RDI project so that information is available if questions arise. Scanned personal data format (PDF) copies of all field forms and appropriate logbook pages, and digital photographs will be stored in each individual electronic property file. A backup electronic copy of the Troy Scribe database and individual electronic property files will be stored outside of the DEQ Troy Information Center, and will be updated periodically for the duration of the sampling, inspection, and reporting phases of the RDI project. Copies of all field sketches, quality assurance/quality control (QA/QC) records, and field logbooks will be available on request at any time during the RDI project to DEQ, EPA, or to the Troy property owners.

After the PDA electronic information is downloaded to the Troy Scribe database, from the RDI field teams, the field sample coordinator will check all building, use area, and sample ID numbers for accuracy. The field sample coordinator will then print out a hard copy of the chain-of-custody form and store these records with the associated samples collected for the OU7 properties. The chain-of-custody report will be transferred to the Environmental Services Assistant Team (ESAT) Laboratory Coordinator.

Until samples have been transferred to the ESAT Laboratory Coordinator, all RDI samples will be securely held by the individual contractors. Samples may be stored in storage bins within locked vehicles or in a secured (locked) area of the DEQ Troy Information Center. All RDI samples collected from the OU7 properties, including QC samples, will be transferred to the ESAT Laboratory Coordinator on a regular basis to be decided prior to initiation of sampling. The ESAT Laboratory Coordinator will provide contractors with a copy of the released chain-of-custody (COC). The ESAT Laboratory Coordinator will then transfer the samples to the on-site laboratory for preparation and then to an off-site laboratory for analysis.

4.4.4 Field Logbooks

Documentation of investigation field activities conducted under this SAP will be recorded in field logbooks maintained specifically for this sampling program. Logbooks are controlled documentation (i.e., sequentially numbered) and maintained by DEQ, USACE, or their contractors.

The logbook is an accounting of activities at the site and will duly note problems or deviations from the governing plans and observations relating to the sampling and analysis program. A new logbook page will be completed for each property visited. The header information should include the address, and the property owner’s name. When closing out a logbook page with lineout and signature, the author will also print his/her name underneath the signature. Original logbooks will be maintained in the DEQ Troy Information Center.

4.4.5 Sample Labeling and Identification

A unique alphanumeric code, or sample ID number, will identify each sample collected during RDI sampling. The coding system will provide a tracking record to allow retrieval of information about a particular sample and to ensure that each sample is uniquely identified. Sample IDs will be sequential and not be representative of any particular building or equipment. Sample IDs will correlate with sample location IDs, which will be identified in the field logbooks.

The sample labeling scheme is as follows:

TD-XXXX

Where:

TD identifies that a sample is collected in accordance with this RDI SAP and XXXX represents a 4-digit numeric code.

Preprinted adhesive sample labels will be signed out to sampling personnel by the sample database manager. The labels are controlled to prevent duplication in assigning sample IDs. The labels will be affixed to both the inner and outer sample bags for soil samples.

4.4.6 Photographic Documentation

Photographs will be taken with a digital camera at any place that field personnel determine necessary. A description of each photograph taken will be recorded in the field logbook in accordance with photographic log protocol (Appendix I of TAPE work plan [Tetra Tech 2007]). A list of photographs in the field logbook should clearly state where each photograph was taken (e.g. building or use area ID number). Electronic photograph files will be saved each day to a project-designated computer housed at the DEQ Troy Information Center and named so that photographs for a particular property or activity can easily be retrieved.

Following completion of RDI activities, all photo files pertaining to a property will be copied onto a compact disc and filed in the DEQ Troy Information Center along with other property-specific documentation.

5.0 LABORATORY OPERATONS

EPA's ESAT will be responsible for all sample analysis, including any sample processing prior to analysis. The contractors will relinquish RDI samples to the EPA Laboratory Coordinator, processing facility, or laboratory, as designated by DEQ, USACE, and EPA. The Sample Coordinator will be responsible for communicating with the EPA Laboratory Coordinator to relay pertinent sample and analysis information including sample quantities; special sample handling requirements, processing, or analysis concerns; and requested turn-around times.

This section discusses the analytical methods, custody and documentation procedures, QA/QC requirements, and data management requirements to be followed by the laboratory in support of the OU7 RDI activities.

5.1 ANALYTICAL METHODS AND TURNAROUND TIMES

This section describes the analytical methods used for RDI samples. The Sample Coordinator will provide the EPA with requested turn-around times for all samples relinquished. In general, it is expected that analysis for all RDI soil and bulk samples will be complete within 2 weeks from the time the laboratory receives them.

5.1.1 SOIL SAMPLES

Prior to analysis, all soil samples require a processing step. Soil samples will be processed using the current version of the Libby soil sample processing SOP (ISSI-LIBBY-01) (ISSI Consulting Group [ISSI] 2000) and the procedures in the *Soil Preparation Work Plan* (TechLaw 2007). The contractor will indicate the current version of the soil sample processing SOP in the analysis request section of the COC. It is the responsibility of the soil preparation facility to specify the appropriate PLM method as it corresponds to the specific sample fraction being submitted for analysis (i.e., fine ground or coarse fraction) on their COCs to the laboratory.

All soil samples collected as part of this effort, including field duplicate samples, will be analyzed for asbestos by the PLM visual estimation method (PLM-VE) and the PLM gravimetric method (PLM-Grav) in accordance with SOPs SRC-LIBBY-03 (Syracuse Research Corporation [SRC] 2003) and SRC-LIBBY-01 (SRC 2002), respectively.

5.1.2 PLM-9002 – BULK MATERIAL SAMPLES

All bulk material samples collected as part of this effort will be analyzed in accordance with National Institute for Occupational Safety and Health (NIOSH) 9002, Issue 2, *Asbestos (Bulk) by PLM* (NIOSH 1994).

Because the level of detection is estimated (at less than 1 percent asbestos) for this method, no specific level of detection has been established for project samples analyzed using NIOSH 9002.

5.2 HOLDING TIMES

For the samples specified for collection in this SAP, no holding time requirements will be employed.

5.3 LABORATORY CUSTODY PROCEDURES

Laboratory custody procedures are described in the laboratory's QA management plan.

The basic laboratory sample custody process is as follows. Upon receipt at the laboratory, each sample shipment will be inspected to assess the condition of the shipment and the individual samples. This inspection will include verifying sample integrity. The accompanying COC will be cross-referenced with all of the samples in the shipment. The laboratory sample custodian will sign the COC and maintain a copy for their project files; the original COC will be appended to the hard copy data report. Next, the sample custodian may assign a unique laboratory number to each sample on receipt. This number will identify the sample through all further handling at the laboratory. It is the laboratory's responsibility to maintain internal logbooks and records throughout sample preparation, analysis, data reporting, and sample archiving.

5.4 LABORATORY QA/QC

The Libby Asbestos Project laboratory QA program consists of laboratory certifications, team training and mentoring, analyst training, and laboratory audits. Subcontract laboratories that analyze field samples on the Libby project must maintain particular certifications and must satisfactorily complete project-specific training requirements to ensure that proper QA/QC practices are conducted during sample analysis.

Each laboratory is required to participate in an onsite laboratory audit carried out by the EPA Superfund Analytical Services Branch, which is independent of the Troy team members.

Lastly, analytical laboratories will be provided a copy of this SAP. Samples collected under this SAP will be analyzed in accordance with standard EPA and/or nationally-recognized analytical procedures in order to provide analytical data of known quality and consistency.

5.5 LABORATORY DOCUMENTATION AND REPORTING

All deviations from project-specific and method analytical guidance documents, or this SAP, will be recorded on a Libby Asbestos Project Laboratory Record of Modification Form (Appendix C). Any deviations that impact, or have the potential to impact, investigation objectives will be discussed with the DEQ prior to implementation. In addition, the Record of Modification Form will be used to document any information of interest as requested by DEQ. As modifications are approved by DEQ and implemented, the EPA Laboratory Coordinator will communicate the changes to the EPA laboratories.

Sample results data will be delivered to the EPA in accordance with the current version of the EPA Data Management Plan (EPA 2010).

5.6 LABORATORY NONCONFORMANCE

Laboratories will immediately notify the EPA Laboratory Coordinator if major problems occur (e.g., catastrophic equipment failure). The EPA Laboratory Coordinator will then notify the RDI Sample Coordinator of potential impacts to turn-around times. Other nonconformance issues, such as those found during performance evaluations or audits, will be addressed on a case-by-case basis by the EPA's laboratory audit team.

6.0 DATA MANAGEMENT

Data management during the RDI will be under the supervision of the Tetra Tech Database Manager in the DEQ Troy Information Center. RDI field crews will generate field data on paper copies, electronic forms, handheld computers, and/or digital photographs. All field data will be managed according to EPA reporting requirements specified in the EPA Data Management Plan (EPA 2010).

These reporting requirements were developed to help satisfy EPA's cleanup objectives at the Libby Asbestos Superfund Site. The reporting requirements guide data collection processes and data reporting procedures for spatial information, tabular data, and documents (EPA 2010).

6.1 TABULAR DATA

The Database Manager will be required to format and submit all tabular data in accordance with EPA reporting requirements (EPA 2010). Operational electronic data will be QC reviewed, entered into a Scribe database, and published to Scribe.net the same day the data are collected. This will ensure that EPA has consistent and up-to-date information.

6.2 DOCUMENTS AND RECORDS

The Records Manager will be required to format and submit all operations documents and records in accordance with EPA reporting requirements (EPA 2010). Documents will be stored in file cabinets at the DEQ Troy Information Center within 10 business days of completion of field activities at a given property.

7.0 QA/QC PROCEDURES

The QA/QC objectives, internal QC checks, and audits completed for the OU7 RDI project are described in the sections below. Field QC control procedures are described in Section 4.4 above.

7.1 QA/QC OBJECTIVES

The QA/QC objectives of the RDI project are to obtain 100 percent usable and accurate data. This will be achieved through inspection and sampling using standardized PDA data entry procedures, auditing field operations, observing chain-of-custody procedures, and analyzing field quality control samples and laboratory quality control samples. The DQOs are described in detail in Section 3.0.

7.2 INTERNAL QC CHECKS

Tetra Tech's Analytical Coordinator will conduct data verification on 100 percent of the RDI data generated. This includes cross-checking that sample IDs and sampling dates have been reported correctly on the laboratory report, that calculated analytical sensitivities or detection levels are as expected, that results have been transferred correctly from laboratory bench sheets to the electronic data deliverable (EDD) to Scribe database, and that the laboratory reports and EDDs are complete. If discrepancies are found, Tetra Tech will notify EPA. The data verification process also includes reviewing field and laboratory QC sample results, as applicable.

In addition, the DQOs presented in Section 3 will be reconciled during the data verification process. This entails comparing the reported results against the project-specific action levels discussed in Section 3. Attainment of project-specific DQOs is necessary to accurately determine what areas do or do not contain LA and /or LA source materials, necessary for development of property-specific removal action plans. Non-attainment of project DQOs may result in additional follow-up visits to the property for additional sample collection and/or field observations.

Since soil samples will be analyzed by EPA ESAT in accordance with Libby Asbestos Superfund Site protocols, including EPA's most recent protocols relating to QA/QC for the Libby Asbestos Superfund Site, the QA/QC protocols followed by the laboratories are not within Tetra Tech's immediate control.

7.3 AUDITS, CORRECTIVE ACTIONS, AND QA REPORTS

Field audits will be an integral part of Tetra Tech's field operations for the duration of the RDI project. Field audits and corrective actions will be the responsibility of EPA and the Tetra Tech QA/QC manager. The field audit forms will be housed in the DEQ Troy Information Center for the duration of the RDI.

7.3.1 Field Inspections and Sampling Procedures Audits

The Tetra Tech QA/QC manager will be responsible for audits of RDI inspections and sampling procedures. Audits will be conducted weekly for the duration of the RDI. Audits will consist of the QA/QC manager or his designee attending a Troy RDI inspection/sampling event and observing the RDI field team's activities. The field team will not be warned of the audit. The auditor will compare the field team's activities with the protocols provided in this SAP and the attached project-specific guidance and evaluate compliance with the protocols using the audit form provided in Appendix C. After the audit, the auditor will provide the completed audit form to the DEQ, EPA, and USACE project managers.

7.3.2 Corrective Action Procedures

The QA/QC auditor may use his or her discretion to provide immediate verbal feedback to the RDI field team, if necessary, to ensure that deficiencies are fixed as quickly as possible. The field team leader and QA/QC manager will review the report with the RDI field team within 48 hours of the audit to correct any deviations or deficiencies. If any deviations or deficiencies were noted, the field team will be audited again within one week of the original audit to ensure that any deficiencies have been fixed. If a field team member is rotated off the project after deviations or deficiencies were noted, the field team members will be audited again within one week of returning to Troy.

If gross deficiencies are noted, the Tetra Tech QA/QC manager will determine whether re-inspection or re-sampling of any Troy properties is required. Re-inspection or re-sampling will be required only if the field team failed to correctly complete the RDI, or collected samples incorrectly.

REFERENCES

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SRC 2003. SRC-LIBBY-03. Analysis of Asbestos Fibers in Soil by Polarized Light Microscopy. March 3. Revision 1, dated December 11, 2003. Revision 2 dated October 10, 2008.

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APPENDIX A

TETRA TECH
SITE-SPECIFIC HEALTH AND SAFETY PLAN
TROY ASBESTOS PROPERTY EVALUATION

(Available to Agencies upon Request)

Health and Safety Plan

for

Troy Asbestos Property Evaluation (TAPE)

HEALTH AND SAFETY PLAN

Troy Asbestos Property Evaluation

Contract No.	:	DEQ 402014-TO41
	:	
Date Prepared	:	5/18/09
Prepared by	:	Tetra Tech EM Inc. (Tetra Tech)
Date Reviewed	:	5/27/09
Reviewed by	:	Denny Cox
Tech Project Manager	:	J. Edward Surbrugg, Ph.D.
Telephone No.	:	(406) 442-5588

REVIEWS AND APPROVALS

CLIENT NAME: Montana Department of Environmental Quality
CONTRACT NO.: DEQ 402014-TO41

We the undersigned have read and approve of the health and safety guidelines presented in this health and safety plan for on-site work activities for the Troy Asbestos Property Evaluation project.

Name	Signature	Date
Denny Cox, Central Region Safety Officer Tetra Tech EM Inc. (Tetra Tech) Health and Safety Representative	Denny Cox	Digitally signed by Denny Cox DN: cn=Denny Cox, c=US, o=Tetra Tech, ou=Central Region Health and Safety Officer, email=denny.cox@ttemi.com Reason: I have reviewed this document Date: 2009.05.27 16:27:47 -05'00'
J. Edward Surbrugg, Ph.D. Tetra Tech Project Manager		5/28/09

This certifies that Tetra Tech has assessed the type, risk level, and severity of hazards for the project and has selected appropriate personal protective equipment for site personnel in accordance with Occupational Safety and Health Administration Title 29 of the *Code of Federal Regulations*, Part 1910.132.

Certified by

Name	Signature	Date
Denny Cox, Central Region Safety Officer Tetra Tech Technical Reviewer	Denny Cox	Digitally signed by Denny Cox DN: cn=Denny Cox, c=US, o=Tetra Tech, ou=Central Region Health and Safety Officer, email=denny.cox@ttemi.com Reason: I have reviewed this document Date: 2009.05.27 16:28:14 -05'00'

EMERGENCY INFORMATION
EMERGENCY CONTACTS AND ROUTE TO HOSPITAL

Emergency Contact	**Telephone No.**
U.S. Coast Guard National Response Center	(800) 424-8802
Montana Department of Emergency Services	(406) 431-0411
InfoTrac Chemical Monitoring System	(800) 535-5053
Fire Department	911
Police Department	911
Tetra Tech EM Inc. Personnel:	
Human Resource Development: Amy Clark	(626) 351-4664
Regional Health and Safety Officer: Denny Cox	(816) 668-7464
Project Manager: J. Edward Surbrugg	(406) 442-5588, ext. 230
Site Safety Coordinator: Mark Stockwell	(208) 263-4524
Alternate Site Safety Coordinators: Colin McCoy	(816) 225-4030
Steve MacNeill	(406) 442-5588
Client Contact: Catherine LeCours	(406) 841-5040
Client Title: Montana DEQ Project Officer	

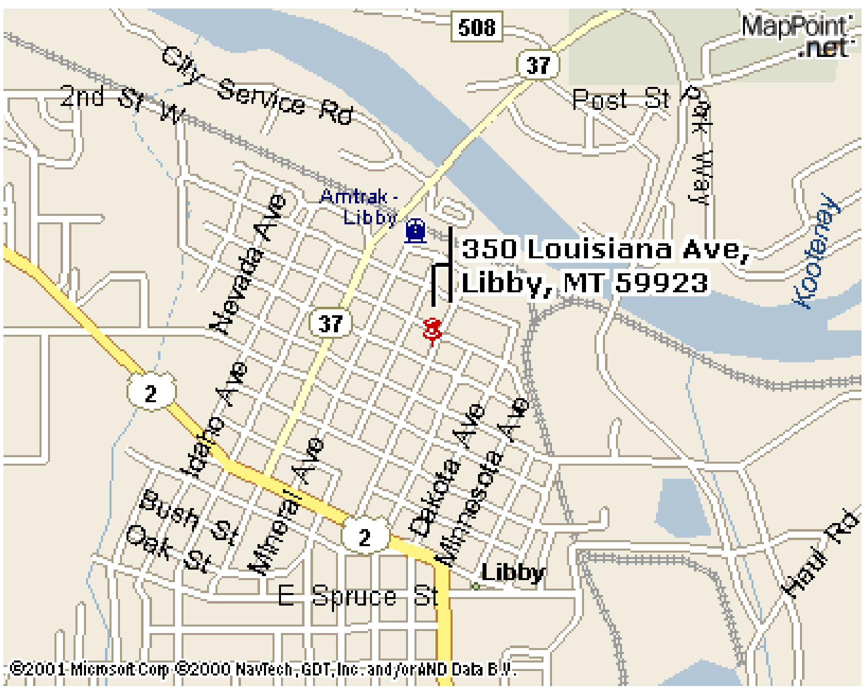
Medical Emergency		
Hospital Name:		St. John's Lutheran Hospital
Hospital Address:		350 Louisiana Avenue Libby, MT 59923
Hospital Telephone No.:	General – 406-293-0100	Emergency – 911
Ambulance Telephone No.:		911

Route to Hospital: (see next page, hospital route map)

1. Routes will differ from each sample site; however, the route from the main east/west highway (US-2) is as follows:
2. Follow Missouri Avenue (US-2) east for 17.0 miles to Libby, Montana
3. Turn left at California Avenue for 0.3 miles
4. Turn right at West 4th Street for 0.2 miles
5. Turn left at Louisiana Avenue for 161 feet.

Note: This sheet must be posted on site.

EMERGENCY INFORMATION
HOSPITAL ROUTE MAP



Note: This sheet must be posted on site.

EMERGENCY INFORMATION

EMERGENCY CONTACTS AND ROUTE TO HOSPITAL

Medical Emergency (secondary – use for major emergency only)	
Hospital Name:	St. John's Lutheran Hospital
Hospital Address:	350 Louisiana Avenue, Libby, MT 59923
Hospital Telephone No.:	Emergency – 911 or General – 406-293-0100
Ambulance Telephone No.:	911
Route to Hospital: (see next page hospital route map) 1. Routes will differ from each sample site; however, the route from the main east/west highway (US-2) is as follows: 2. Follow Missouri Avenue (US-2) east for 17.0 miles to Libby, Montana 3. Turn left at California Avenue for 0.3 miles 4. Turn right at West 4th Street for 0.2 miles 5. Turn left at Louisiana Avenue for 161 feet..	

CONTENTS (Cont.)

CONTENTS (Cont.)

FIGURES

TABLES

1.0 INTRODUCTION

This document addresses items specified under Occupational Safety and Health Administration (OSHA) Title 29 of the *Code of Federal Regulations* (CFR), Part 1910.120 (b), "Final Rule," and 29 CFR 1910.1001. This health and safety plan (HASP) will be available to all on-site personnel who may be exposed to hazardous on-site conditions, including Tetra Tech EM Inc. (Tetra Tech) and subcontractor personnel, and all site visitors and regulatory agency representatives. The site-specific health and safety provisions in this document have been developed for use during the Troy Asbestos Property Evaluation (TAPE) inspection and sampling

This HASP defines requirements and designates protocols to be followed during the TAPE inspection and sampling. All personnel on site, including Tetra Tech and subcontractor employees and site visitors, must be informed of site emergency response procedures and any potential health or safety hazards associated with on-site activities. This HASP summarizes potential hazards and defines protective measures planned for activities at the site.

This plan must be reviewed and approved by the Tetra Tech health and safety representative (HSR), or a designee, and the Tetra Tech project manager (see the Reviews and Approvals form after the contents in this document). All personnel must sign the Compliance Agreement form in Appendix A before they enter the site. Protocols established in this HASP are based on site conditions and health and safety hazards known or anticipated to be present and on available site data. This plan is intended solely for use during proposed activities described in the corresponding site-specific work plan. Specifications are subject to review and revision based on actual conditions encountered in the field during site activities. The Tetra Tech project manager and the Tetra Tech HSR must approve significant revisions to this plan. Tetra Tech employees must also follow safety requirements taught during safety training and described in the Tetra Tech, Inc., "Health and Safety Manual" (1999).

2.0 HEALTH AND SAFETY PLAN ENFORCEMENT AND PERSONNEL

This section describes responsibilities of project personnel, summarizes requirements for subcontractors and visitors who wish to enter the site during the survey and sampling, and discusses HASP enforcement.

2.1 PROJECT PERSONNEL

The following personnel and organizations are associated with planned activities at the site. The organizational structure will be reviewed and updated as necessary during the course of the project.

Name/Title	Responsibility	Telephone No.
Client Representative:		
Ms. Catherine LeCours	Montana Department of Environmental Quality (DEQ) Representative	(406) 841-5040
Tetra Tech Personnel:		
J. Edward Surbrugg	TAPE Project Manager	(406) 442-5588 x 230
Mark Stockwell	Site Safety Coordinator (SSC)	(208) 263-4524
Mark Stockwell	Field Team Manager	(208) 263-4524

The Tetra Tech project manager, contract manager, SSC, and field team leader will be responsible for implementation and enforcement of the provisions of this HASP, including completion of all applicable forms provided as appendices to this HASP. Their duties and the expectations for Tetra Tech employees are described in the following sections.

2.1.1 Project Manager and Field Team Manager

The Tetra Tech project manager has ultimate responsibility for implementing the requirements set forth in this HASP. Some of this responsibility may be achieved through delegation to site-dedicated personnel who report directly to the project manager. The project manager shall regularly confer with site personnel on compliance with safety and health requirements.

The Tetra Tech field team manager will oversee and direct field activities and has day-to-day responsibility for implementing the HASP. The field team manager will report any health and safety-related issues directly to the project manager.

2.1.2 Site Safety Coordinator

The Tetra Tech SSC will be appointed by the project manager and will be responsible for field implementation of tasks and procedures contained in this HASP, including air monitoring, establishing a decontamination protocol, and ensuring that all personnel working on site have signed the Daily Tailgate Safety Meeting form (Form HST-2) and the Compliance Agreement (Form HSP-4) (see Appendix A). The SSC will have advanced field work experience and be familiar with health and safety requirements specific to the project. The SSC will also maintain the Daily Site Log (Form SSC-1 in Appendix A).

2.1.3 Health and Safety Representative

The Tetra Tech HSR is responsible for administration of the company health and safety program. The HSR will act in an advisory capacity to project managers and site personnel for project-specific health and safety issues.

2.1.4 Tetra Tech Employees

Tetra Tech employees are expected to fully participate in implementing the site HASP by obtaining necessary training, attending site safety meetings, always wearing designated personal protective equipment (PPE), complying with site safety and health rules, and advising the Tetra Tech SSC of health and safety concerns at the site.

2.2 SUBCONTRACTORS

Subcontractors will follow and adhere to the same guidelines stated in Section 2.1.4, however they should provide their own health and safety documentation for the protection of their employees. Tetra Tech has prepared this HASP solely for the protection of Tetra Tech employees, and assumes no responsibility for the protection of others. Subcontractors must supply their own PPE, training, medical monitoring, and any other items necessary for compliance with State, OSHA and other pertinent regulations.

2.3 VISITORS

All site visitors will be required to read the HASP and sign the Compliance Agreement form (see Appendix A). Visitors will be expected to comply with relevant OSHA requirements. Visitors will also be expected to provide their own PPE as required by the HASP. Visitors who have not met OSHA requirements for training, medical surveillance, and PPE are not permitted to enter areas where exposure to hazardous materials is possible.

2.4 HEALTH AND SAFETY PLAN ENFORCEMENT

This HASP applies to all site activities and all personnel working on the TAPE project. HASP enforcement shall be rigorous. Violators of the HASP will be verbally notified on first violation, and the Tetra Tech SSC will note the violation in a field logbook. On a second violation, the violator will be notified in writing, and the Tetra Tech project manager and the violator's supervisor will be notified. A third violation will result in a written notification and the violator's eviction from the site. The written notification will be sent to human resources development and the HSR.

Personnel will be encouraged to report to the SSC any conditions or practices that they consider detrimental to their health or safety or that they believe violate applicable health and safety standards. These reports may be made orally or in writing. Personnel who believe that an imminent danger threatens human health or the environment are obligated to remove themselves from the area or the hazardous condition and warn all other personnel of the source of the danger. The hazardous condition or matter will be brought to the immediate attention of the SSC for resolution.

At least one copy of this HASP will be available to all site personnel at all times. The SSC will discuss minor changes in HASP procedures at the beginning of each workday at the daily tailgate safety meeting. Significant plan revisions must be discussed with the HSR and project manager, and approved by the HSR.

3.0 SITE BACKGROUND

The TAPE inspection and sampling project will include collecting soil samples from private and public property to evaluate the magnitude and extent of asbestos contamination. The following sections describe the TAPE site, its history, and activities planned for this project. The location of Troy, Montana, is shown in Figure 1.

FIGURE 1 – SITE LOCATION

3.1 SITE DESCRIPTION

Troy, Montana, is located 18 miles from Libby, Montana. Through 1990, a vermiculite mine and associated processing operations in Libby produced a large amount of the world supply of vermiculite. The vermiculite deposit is contaminated with a form of amphibole asbestos (Libby amphibole). Asbestos is a known carcinogen and is associated with a multitude of respiratory health effects, including asbestosis, lung cancer, and mesothelioma. For decades, contaminated vermiculite and associated waste materials have been ubiquitous in the community while the mine operated and after its closure. Many of the mine workers lived in Troy and commuted to work at the mine. Workers were exposed to contaminated materials at the mine and processing facilities and transported contaminated dust to their homes on clothes and equipment. Vermiculite and contaminated waste rock in varying forms was used in soils (as fill or an amendment), construction materials, and for insulation in various locations in Troy.

In 1999, U.S. Environmental Protection Agency (EPA) Region 8 dispatched an emergency response team to investigate media reports that described a high rate of asbestos-related deaths in Libby. Originally believed to be a problem limited to the mine workers, the scope has recently increased. Subsequent environmental investigations have found many areas in Libby with Libby Amphibole (LA) contamination. EPA began Superfund emergency response removal actions in Libby in 2000 that are ongoing through 2009. Properties in Troy are being investigated to evaluate whether LA-contaminated vermiculite has been transported to these sites and if it exists at concentrations that would pose risks to human health.

3.2 PLANNED ACTIVITIES

Activities to be performed during the TAPE include the following:

Indoor Inspections: The two-person sampling team will visually inspect each structure for the presence of vermiculite-containing insulation (VCI).

Outdoor Inspection: All areas of a property that are not special use areas or covered with structures will be visually inspected for vermiculite product in soil and surfacing materials.

Outdoor Soil Sampling: While conducting the visual inspection of the property, the sampling team will collect soil samples. Soil samples will be collected at all properties, whether visual VCI or LA is observed or not.

Aggressive Attic Inspections: When attic access locations are limited and the entire space cannot be adequately inspected from the available access locations, a field technician will enter the attic with his/her full body to perform the necessary inspection and collect samples of any VCI present. This procedure is described in Appendix C.

4.0 EVALUATION OF SITE-SPECIFIC HAZARDS

Field activities and physical features of the site may expose field personnel to a variety of hazards. This section provides information on potential hazards related to site activities and the nature of effects from hazardous materials.

4.1 CHEMICAL HAZARDS

Tremolite-actinolite asbestos is the only potentially hazardous substance anticipated to be encountered during site activities. Potential routes of exposure, exposure limits, and the toxic characteristics of asbestos are listed in Table 4-1. The primary route of exposure is inhalation; however, secondary potential routes of exposure include dermal (skin) contact and ingestion. Asbestos may also contaminate equipment, vehicles, instruments, and personnel. The overall health threat to Tetra Tech employees from exposure to asbestos during this project is uncertain because: (1) actual concentrations that personnel could be exposed to cannot be predicted until assessments and sampling activities begin, (2) the actual duration of exposure is unknown, and (3) the effects of low-level exposure to a mixture of chemicals or asbestos cannot be predicted.

Specific information on potential chemical hazards at the site is provided in Table 4-1. Table 4-2 provides a task hazard analysis of the activities planned and listed in Section 3.2.

Tetra Tech will not bring any potentially hazardous materials to the site during the field activities. Because of the nature of asbestos sampling, all PPE and monitoring equipment can be decontaminated using soap and water. Air monitoring equipment to be used during this project will be calibrated without the use of hazardous materials.

TABLE 4-1

POTENTIAL CHEMICAL HAZARDS
TAPE INSPECTION AND SAMPLING PROJECT

Chemical	Exposure Limits and IDLH Level	Exposure Routes	Toxic Characteristics
Asbestos	OSHA PEL: 0.1 fiber/cm^3 (8 hour TWA) OSHA Excursion Limit: 1 fiber/ cm^3 (30 minute exposure) ACGIH TLV: 0.1 fiber/cm^3 NIOSH REL: 0.1 fiber/ cm^3 IDLH: Not Established	Inhalation (primary), ingestion, skin or eye contact	Lung cancer, mesothelioma, Asbestosis (chronic exposure): dyspnea (breathing difficulty), interstitial fibrosis, restricted pulmonary function, finger clubbing; eye irritation

Notes:

ACGIH	American Conference of Governmental Industrial Hygienists
IDLH	Immediately dangerous to life or health
cm^3	Cubic centimeter
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PEL	Permissible exposure limit
ppm	Part per million
REL	Reference Exposure Level
TLV	Threshold limit value
TWA	Time weighted average

Sources: ACGIH. "Threshold Limit Values and Biological Exposure Indices for 1998." Latest edition.

National Institute for Occupational Safety and Health. 2004. "Pocket Guide to Chemical Hazards." U.S. Department of Health and Human Services. U.S. Government Printing Office. Washington, DC. June.

TABLE 4-2

TASK HAZARD ANALYSIS
TAPE Inspection and Sampling Project

Task	Potential Hazard	Controls	Initial Level of Protection	Upgraded Level of Protection
Task 1 – Interior Attic Evaluations and air monitoring	Potential asbestos exposure. Physical hazards include confined space entry; and slips, trips, falls, overhead hazards, and heat related hazards. Risks associated with ladder use. Risks associated with falls between roof trusses.	Use of buddy system at all times, use of flashlights when necessary, hazard awareness. Inspections will be conducted to limit the potential for exposure. Performance of personal air monitoring at selected locations. Follow Safe Work Practices (SWP).	Level C protection when accessing all attic spaces. Initial use of PAPR respirators	Level C protection will be required when accessing all attic spaces
Task 2 – Exterior yard and open area inspections, and soil sampling	Potential asbestos exposure. Physical hazards include slips, trips, and falls.	Use of buddy system and hazard awareness. Follow SWPs including the use of PPE whenever LA is observed, proper decontamination procedures, physical and biological safety procedures, and emergency and communication procedures.	Level C protection until a negative exposure assessments NEA has been obtained. Level D protection for general soil sampling, although respirators will be required whenever LA or VCI is observed. Disposable booties will be required whenever sampling in loose soil or special use areas.	Potential for upgrade to level C protection may be necessary using P-100 cartridges. Full or ½ face respirator can be used. Decision to upgrade to be made by the SSC/field manager based on site conditions, monitoring results, and presence of friable asbestos.

Notes:
PAPR Powered Air Purifying Respirator
NEA Negative Exposure Assessments

The following steps will be taken to reduce the potential for inhaling asbestos:

- Personnel will avoid sampling methods and procedures that would cause nonfriable asbestos-containing material (ACM) to become friable, such as not wetting soils prior to sampling.
- The level of PPE shall be upgraded from level D to level C at any time that sampling conditions warrant, as determined by the SSC or field manager.

4.2 PHYSICAL AND BIOLOGICAL HAZARDS

Physical and biological hazards associated with site activities present a potential threat to on-site personnel. Dangers are posed by slippery surfaces, unseen obstacles, poor illumination, use of ladders, and low overhead clearance, as well as insects, Hantavirus, and hostile animals.

Injuries resulting from physical and biological hazards can be avoided by using safe work practices (SWP). To maintain a safe workplace, the SSC will conduct and document regular safety inspections and will make sure that all Tetra Tech workers and visitors are informed of any potential physical and biological hazards related to the site. Physical and biological hazards that have been identified at this site include the following:

- Spiders, including brown recluse and black widow
- Potential disease agents from animal/bird feces, including Hantavirus and Histoplasmosis
- Hostile domestic or stray animals, or building occupants
- Ladders and other equipment used to access attics and areas for sample collection
- Trips, slips, falls in yards and open areas
- Heat stress
- Cold stress
- Fall hazard (from ladders and through roof trusses in attics)
- Potential confined space entry – no permits are anticipated to be necessary for sampling, however, occupants will be asked to provide information on any known or potential hazards in basements, crawl spaces or other areas. If presence of hazards is confirmed by the occupant, Tetra Tech field team members will not enter those areas.

5.0 TRAINING REQUIREMENTS

All on-site personnel who may be exposed to hazardous conditions, including Tetra Tech and subcontractor personnel and site visitors who will participate in on-site activities, will be required to meet training requirements outlined in 29 CFR 1910.120, “Hazardous Waste Operations and Emergency Response,” And 29 CFR 1910.1001. In addition, all Tetra Tech personnel participating in aggressive attic inspections shall be trained as either an Asbestos Hazard Emergency Response Act (AHERA) contractor/supervisor or worker meeting the requirements of 29 CFR 1926.32 (f) and the EPA's Model Accreditation Plan (40 CFR 763). All personnel and visitors entering the site will be required to review this HASP and sign the Compliance Agreement form (HSP-4), and site workers will be required to sign the Daily Tailgate Safety Meeting form (HST-2) (see Appendix A).

Personnel collecting asbestos samples will, at a minimum, be 40-hour HAZWOPER trained, have current 8-hour HAZWOPER refresher training, be respiratory protection trained, asbestos awareness trained, and have a copy of these certificates on their person or on file in the DEQ Troy Information Center at all times they are on-site performing work. Additionally, a copy of a current respirator fit-test will be on-site for each employee performing work.

The field team will also received a training module on confined space issues during the site-specific health and safety training prior to beginning the survey. All staff will be trained on how to identify confined spaces, and what defines a permit required confined space. As some of the attic spaces and crawl spaces meet the traditional definition of a confined space, but will need to be inspected or sampled, Tetra Tech will restrict access to spaces smaller than 30-inches high and 10-by 10-feet in size. Tetra Tech will ventilate all crawl spaces and attics with a 600 cfm air filtration machine for at least 10 minutes prior to accessing excessively hot attics to provide cooling and fresh air intake. The air filtration unit will be activated once the access hatch to the crawl space or attic is opened and remain running until decontamination procedures are completed.

Before on-site activities begin, the Tetra Tech SSC will present a briefing for all personnel who will participate in on-site activities. The following topics will be addressed during the pre-work briefing:

- Names of the SSC and the designated alternate
- Site history

- Tasks
- Hazardous chemicals that may be encountered on site
- Physical hazards that may be encountered on site
- PPE, including type or types of respiratory protection to be used for work tasks
- Training requirements
- Action levels and situations requiring upgrade or downgrade of level of protection
- Site control measures, including site communications, and SWPs
- Decontamination procedures
- Confined space entry
- Aggressive attic entry procedures
- Emergency communication signals and codes
- Personnel exposure and accident emergency procedures (in case of falls, exposure to hazardous substances, and other hazardous situations)
- Emergency telephone numbers
- Emergency routes

Any other health and safety-related issues that may arise before on-site activities begin will also be discussed during the pre-work briefing.

Issues that arise during on-site activities will be addressed during tailgate safety meetings to be held daily before the workday or shift begins. The briefings will be documented on the Daily Tailgate Safety Meeting form (Form HST-2 in Appendix A). Any changes in procedures or site-specific health and safety-related matters will be addressed during these meetings.

6.0 PERSONAL PROTECTION REQUIREMENTS

The levels of PPE to be used for work tasks during the TAPE will be selected based on known or anticipated physical hazards; types and concentrations of contaminants that may be encountered on site; and contaminant properties, toxicity, exposure routes, and matrices. The following sections describe protective equipment and clothing; reassessment of protection levels; limitations of protective clothing; and respirator selection, use, and maintenance.

6.1 PROTECTIVE EQUIPMENT AND CLOTHING

Personnel will wear protective equipment when: (1) site activities involve known or suspected contamination; (2) site activities may generate asbestos particulates; or (3) direct contact with hazardous materials may occur. The anticipated levels of protection selected for use by field personnel during site activities are listed in Table 4-2, Task Hazard Analysis. Based on the anticipated hazard level, personnel will initially perform exterior soil sampling and indoor inspection field tasks in level D protection, described below. Based on the anticipated hazard level for non-aggressive attic entry, personnel completing this task will perform the inspection procedure in Level C PPE using at a minimum half face negative pressure respirators. Finally, based on the anticipated hazard level for aggressive attic entry, personnel completing this task will perform the inspection procedure in Level C PPE using at a minimum full face PAPR respirator or until a successful NEA is completed indicating a downgrade to half face negative pressure respirators.

If site conditions or the results of air monitoring during on-site activities warrant a higher level of protection, field personnel will immediately notify the Tetra Tech SSC. Based on the initial site walk-through and conditions encountered during sample collection, a PPE upgrade to level C protection is anticipated in some of the areas to be sampled. This PPE upgrade will typically occur whenever vermiculite-containing insulation (VCI) or Libby vermiculite (LV) is encountered. Equipment and clothing required for level D and level C protection are:

- Level D
  - Disposable Coveralls (such as Tyvek or Polypropylene coveralls)
  - Disposable gloves (latex or vinyl), if applicable
  - Work gloves, if applicable
  - Sturdy work boots or shoes
  - Disposable boot covers
  - Safety glasses or goggles
  - Hard hat (face shield optional), if needed
  - Hearing protection

- Level C
  - Disposable Coveralls (such as Tyvek or Polypropylene coveralls)
  - Outer gloves (neoprene, nitrile, or other), if applicable
  - Disposable inner gloves (latex or vinyl)
  - Sturdy work boots or shoes
  - Disposable boot covers
  - PAPR or full- or half-face, air-purifying respirator with NIOSH-approved cartridges to protect against organic vapors, dust, fumes, and mists. (Cartridges used for gas and vapors must be replaced in accordance with the change-out schedule described in the Respiratory Hazard Assessment form [Form RP-2] in Appendix C.) P-100 cartridges will be used.
  - Safety glasses or goggles (with a half-face respirator only)
  - Hard hat (face shield optional), if needed
  - Hearing protection (for areas with a noise level that exceeds 85 decibels on the A-weighted scale)

6.2 REASSESSMENT OF PROTECTION LEVELS

PPE levels will be upgraded or downgraded based on a change in site conditions or findings of the investigation. Hazards will be reassessed when a significant change in site conditions occurs. Some indicators of the need for reassessment are as follows:

- Commencement of a new phase of work, such as the start of a significantly different sampling activity or work that begins on a different portion of the site
- Potential for release of amphibole asbestos
- A change in tasks during a work phase
- A change of season or weather
- Temperature extremes or individual medical considerations that would limit the effectiveness of PPE
- Discovery of contaminants other than those previously identified
- A change in ambient levels of airborne contaminants (see the action levels listed in Table 8-1)
- A change in work scope that affects the degree of contact with contaminated media

6.3 LIMITATIONS OF PROTECTIVE CLOTHING

PPE clothing ensembles designated for use during site activities have been selected to protect against contaminants at known or anticipated on-site concentrations and physical states. However, no protective garment, glove, or boot is entirely chemical-resistant, nor does any protective clothing protect against all types of chemicals. Permeation of a chemical through PPE depends on the contaminant concentration, environmental conditions, the physical condition of the protective garment, and the resistance of the garment to the specific contaminant. Chemical permeation may continue even after the source of contamination has been removed from the garment. The Tetra Tech field staff will be trained to avoid property areas where chemical hazards are present; therefore, the use of chemical resistant PPE is not anticipated.

All site personnel will use the following procedures to obtain optimum performance from PPE:

- When protective coveralls become contaminated, don a new, clean garment after each rest break or immediately after sampling is completed.
- Inspect all clothing, gloves, and boots both before and during use for:
  - Imperfect seams
  - Non-uniform coatings
  - Tears
  - Poorly functioning closures
- Inspect reusable garments, boots, and gloves both before and during use for visible signs of chemical permeation, such as:
  - Swelling
  - Discoloration
  - Stiffness
  - Brittleness
  - Cracks
  - Punctures
  - Abrasions

Reusable gloves, boots, or coveralls that exhibit any of the characteristics listed above must be discarded. Reusable PPE will be decontaminated in accordance with procedures described in Section 10.0 and will be neatly stored in the support zone away from work zones.

6.4 RESPIRATOR SELECTION, USE, AND MAINTENANCE

Tetra Tech personnel will be informed of the proper use, maintenance, and limitations of respirators during annual health and safety refresher training and the pre-work briefing. Any on-site personnel who will use a tight-fitting respirator must pass a qualitative fit test for the respirator that follows the fit testing protocol provided in Appendix A of the OSHA respirator standard (29 CFR 1910.134). Fit testing must be repeated annually or when a new type of respirator is used. If exposure to asbestos on this project is expected to exceed 10 times the OSHA PEL, a quantitative respirator fit-test must be performed for all employees wearing respirators.

Respirators are selected based on the assessment of the nature and extent of hazardous atmospheres anticipated during field activities. This assessment includes a reasonable estimate of employee exposure to respiratory hazards and identification of each contaminant's anticipated chemical form and physical state.

A respiratory hazard assessment has been conducted for each task that will require use of a respirator during the TAPE project. The results of this assessment are documented in the Respiratory Hazard Assessment form (Form RP-2), which has been approved by the HSR. The completed Form RP-2 is included in Appendix C and defines respiratory protection requirements for the project. Amendments to this HASP and to Form RP-2 will be discussed during daily tailgate safety meetings.

When the atmospheric contaminant is identified and its concentration is known or can be reasonably estimated, respiratory protection options include:

- An air-purifying respirator equipped with a NIOSH-certified, end-of-service-life indicator (ESLI) for the identified contaminant. If no ESLI is available, a change-out schedule for cartridges must be developed based on objective data or information. The HSR will evaluate respirator cartridge selection and change-out schedules during the respiratory hazard assessment. The Respiratory Hazard Assessment, Form RP-2, will describe the information and data used as the basis for the cartridge change-out schedule and the proposed change schedule.

For protection against particulate contaminants including friable asbestos, approved respirators can include:

- A powered air purifying respirator (PAPR)
- A respirator equipped with a filter certified by NIOSH under 32 CFR Part 11 or 42 CFR Part 84 as a P100 filter (formerly known as a high-efficiency particulate air [HEPA] filter)

A PAPR or a full- or half-face, air-purifying respirator equipped with NIOSH-approved cartridges or filters will be selected to protect against particulates, vapors, gases, and aerosols for any tasks performed in level C PPE.

Air-purifying respirators will be used only in conjunction with breathing-space air monitoring, which must be conducted in adherence to the action levels outlined in Table 8-1. Air-purifying respirators will be used only when they can protect against the substances encountered on site.

Factors that would preclude use of level C and air-purifying respirators are:

- Concentrations of substances that may be immediately dangerous to life and health
- Confined or unventilated areas that may contain airborne contaminants not yet characterized
- Unknown contaminant concentrations or concentrations that may exceed the maximum use levels for designated cartridges documented in the selected cartridge manufacturer's instructions
- Unidentified contaminants
- High relative humidity (more than 85 percent, which reduces the sorbent life of the cartridges)
- Respirator cartridges with an undetermined service life

Use, cleaning, and maintenance of respirators are described in SWP 6-27, Respirator Cleaning Procedures, and SWP 6-28, Safe Work Practices for Use of Respirators. These SWPs are included in Appendix B.

7.0 MEDICAL SURVEILLANCE

The following sections describe Tetra Tech's medical surveillance program, including health monitoring requirements, site-specific medical monitoring, and medical support and follow-up requirements. Procedures documented in these sections will be followed for all activities during the TAPE project. Additional requirements are defined in the Tetra Tech, Inc., "Health and Safety Manual."

7.1 HEALTH MONITORING REQUIREMENTS

All Tetra Tech and subcontractor personnel involved in on-site activities for the TAPE project must participate in a health monitoring program as required by 29 CFR 1910.120(f). Tetra Tech has established a health monitoring program with WorkCare, Inc., of Orange, California. Under this program, Tetra Tech personnel working on this project will receive baseline and annual physical examinations consisting of:

- Complete medical and work history
- Physical examination
- Vision screening
- Audiometric screening
- Pulmonary function test
- Resting electrocardiogram
- Chest x-ray (required once every 3 years)
- Blood chemistry, including hematology and serum
- Urinalysis
- For sampling asbestos, licensed workers will meet the medical monitoring requirements of their licenses

Tetra Tech receives a copy of the examining physician’s written opinion for each employee after post-examination laboratory tests have been completed. The Tetra Tech employee also receives a copy of the written opinion. This opinion includes the following information (in accordance with 29 CFR 1910.120[f][7]):

- The results of the medical examination and tests
- The physician’s opinion as to whether the employee has any medical conditions that would place the employee at an increased risk of health impairment from work involving hazardous waste operations or during an emergency response
- The physician’s recommended limitations, if any, on the employee’s assigned work; special emphasis is placed on fitness for duty, including the ability to wear any required PPE under conditions expected on site (for example, temperature extremes)

- A statement that the employee has been informed by the physician of the medical examination results and of any medical conditions that require further examination or treatment

All subcontractors must have health monitoring programs conducted by their own clinics in compliance with 29 CFR 1910.120(f) and 29 CFR 1910.1001. Any visitors or observers at the site will be required to provide records in compliance with 29 CFR 1910.120(f) before they can enter the site.

7.2 MEDICAL SUPPORT AND FOLLOW-UP REQUIREMENTS

All employees are entitled to and encouraged to seek medical attention and physical testing as a follow-up to an injury that requires care beyond basic first aid, or to possible exposure above established exposure limits. These injuries and exposures must be reported to the HSR. Depending on the type of injury or exposure, follow-up testing, if required, must occur within 24 to 48 hours of the incident. It will be the responsibility of the employer’s medical consultant to advise the type of test required to accurately monitor for exposure effects. The Tetra Tech SSC must complete the Incident Investigation Report (Form IR in Appendix A) in the event of an accident, illness, or injury. A copy of this form must be forwarded to the HSR for use in determining whether the incident should be recorded and to be included in Tetra Tech’s medical surveillance records.

8.0 ENVIRONMENTAL MONITORING AND SAMPLING

Environmental monitoring or sampling will be conducted to assess personnel exposure levels as well as site or ambient conditions and to establish appropriate levels of PPE. The following sections discuss initial and background air monitoring, personal monitoring, ambient air monitoring, monitoring parameters and devices, use and maintenance of survey equipment, thermal stress monitoring, and noise monitoring. Site-specific air monitoring requirements and action levels are provided in Table 8-1.

8.1 INITIAL AND BACKGROUND AIR MONITORING

Initial air monitoring of a typical work area will be performed at the beginning of the field sampling project to document airborne fiber levels in attic spaces, in the Troy public information center and field office, and in the interior of some houses that contain VCI or LV. These background samples, designated as “stationary samples” in the TAPE, are designed to provide baseline data at the beginning of the TAPE and health and safety quality assurance periodically during the process. Background micro-vacuum samples will also be collected inside Tetra Tech’s rental vehicles at the beginning of the project, monthly during the project, and prior to returning the vehicles.

Initial exposure assessments will also be required for personnel who participate in the TAPE project. Personal air monitoring will be required during the initial phase of the TAPE to document airborne exposures. The assessments must be used to document typical exposures during specific types of field activities to establish the PPE level required during these activities.

This exposure assessment will be conducted for each field sampling team. The exposure levels must be documented before the levels of PPE required during the work can be downgraded. The assessments must also be conducted using personal air sampling whenever there is a change in working conditions or tasks being performed.

TABLE 8-1

SITE-SPECIFIC AIR MONITORING REQUIREMENTS AND ACTION LEVELS

Contaminant or Hazard	Task	Monitoring Device	Action Level	Monitoring Frequency	Action[a]
Asbestos	Tasks 1 and 2	Gilair-5 Air Sampler (personal)	<one half of PEL or TLV	Select locations – presence of friable asbestos	Results will be received the day after sampling. Work practices will be changed accordingly.

Notes:

< Less than
PEL Permissible exposure limit
TLV Threshold limit value
[a] Refer to Table 4-2 for specific types of gloves, chemical resistant clothing, respirators, and cartridges

8.2 PERSONAL MONITORING

The employees working closest to a source of contamination have the highest likelihood of exposure to airborne contaminant concentrations that may exceed established exposure limits. Therefore, the workers who are closest to a source of contaminant generation will be selectively monitored during site activities. Personal monitoring will be conducted in the breathing zone and, if a worker is wearing respiratory protective equipment, outside the face piece. The breathing zone air will be monitored for Tetra Tech employees working at select locations, such as in the presence of friable asbestos. Work that results in potential employee exposure to airborne asbestos above the prescribed PEL or short term exposure limit (STEL) requires an exposure assessment regulated under the OSHA reference method 29 CFR Part 1910.1001. The determinations of employee exposure will be made from breathing zone air samples representative of the 8-hour TWA and 30-minute STEL for each employee work category. The PEL is 0.1 f/cc for the 8-hour TWA, and the STEL is 1.0 f/cc over a 30-minute period as set forth in 29 CFR Part 1910.1001 (j)(2)(iii).

Many activities anticipated during the TAPE may cause exposure of workers to LA. These activities include Task 1 and 2 procedures. If sampling or disturbance of these materials occurs by duly trained employees, initial air monitoring will be required since such activities could constitute asbestos disturbance procedures as defined by 29 CFR Part 1926.1101. The initial exposure assessments will be representative of each specific work situation at hand. Factors to be weighed include (but are not limited to) type of work, condition of the materials, air monitoring results from similar tasks, and all elements that could make the work more difficult (such as obstructions, high temperature areas, and poor reach areas). Tetra Tech anticipates collecting initial exposure assessment samples for each employee job category for each project team. Exposure assessment samples will also be collected on new field team members that rotate into the project over the course of the TAPE. Exposure assessment samples will also be collected periodically during the course of the TAPE as part of Tetra Tech’s Quality Assurance and Quality Control (QA/QC) process.

Tetra Tech initial exposure assessments will be designed to provide NEAs to demonstrate that employee exposures will be below the PEL or STEL for each representative TAPE tasks. The monitoring and analysis will be performed in compliance with the OSHA asbestos standard in effect. The NEA can be used in the initial exposure assessment to reduce or eliminate the need for respiratory protection if all applicable criteria are met.

Air monitoring will be performed to calculate the airborne fiber concentration to ensure that employee exposure remains below the PEL and STEL The worker's exposure will be measured by first collecting an air sample from within the breathing zone (within 12 inches from the nose) throughout an entire work-shift. This measurement usually necessitates that workers wear the pump near the waist. The personal air monitoring will be evaluated based on the different work activities that are being conducted. A representative set of air samples will be collected during activities that represent typical field days during the TAPE.

The sampling pump flow rates will be between 0.5 liters/minute and 2.5 liters/minute when using a 25-millimeter cassette. Once this sample is analyzed, the results shall be used to calculate the average level of exposure during the complete workshift (the time weighted average, TWA). The TWA is calculated as follows:

$$TWA = \frac{C1\ T1 + C2\ T2 + C3\ T3}{T1 + T2 + T3}$$

T = sample times (duration of exposure in minutes or hours)
C = airborne asbestos fiber concentration (in fibers per cubic centimeter, f/cc)

The TWA results will then be used for comparison to the PEL and to evaluate compliance with permissible exposure limits as established by OSHA. They will also be used to dictate which type of respiratory protection is required to ensure that the PEL is not exceeded.

Personal air samples will also be collected and analyzed in the manner described above for comparison to the PEL and STEL. Sample filters will be analyzed using Phase Contrast Microscopy (PCM) methodology by laboratory personnel (1) trained in NIOSH 582 microscopist (or equivalent) courses and (2) participating in a quality control program meeting the requirements established in 29 CFR 1926.1101. The NIOSH method used for this analysis will be Method 7400. The PCM analytical method is designed to identify all fibers of specific size and shape characteristics but not to distinguish between asbestos and non-asbestos fibers. PCM sample results are reported in fibers per cubic centimeter of air (f/cc). Tetra Tech will request that all sample filters be returned from the laboratory after analysis to be archived. Tetra Tech will use one of several laboratories for analysis, including: (1) Betta Environmental Associates, Inc. in Newark, Delaware; (2) EMSL Analytical, Inc. in Westmond, New Jersey; (3) EMSL Analytical, Inc. in Libby, Montana; (4) Hygeia Laboratories, Inc. in Sierra Madre, California, (5) MAS in

Suwannee, Georgia; and (6) Reservoirs Environmental, Inc. in Denver, Colorado. All of these laboratories are accredited though the National Voluntary Laboratory Accreditation Program (NVLAP).

8.3 MONITORING PARAMETERS AND DEVICES

The following sections below briefly describe the use and limitations of instruments used to monitor for asbestos, combustible atmospheres, percent oxygen, and particulates. Site-specific air monitoring requirements and action levels are listed in Table 8-1.

All monitors will be calibrated in accordance with manufacturer recommendations prior to and subsequent to use for sampling purposes (pre-and post-calibration). Pre and post-calibration results will be averaged to determine the average flow-rate being drawn through the pump for a particular sampling period. Calibration data and other pertinent air monitoring data will be recorded in the field logbook.

8.3.1 Asbestos

Air monitoring will be conducted selectively during sampling to provide information on exposure and identify the need for upgrades from level D PPE to level C PPE. In addition, air monitoring will be conducted to make certain that asbestos is not being released to the areas used by workers as a result of sampling.

Work during the TAPE will be initially conducted in level C PPE; however, after negative exposure assessments are documented, level D will be allowed for exterior soil sampling procedures if no visible VCI or LV is present. Level C PPE using, at a minimum, half face negative pressure respirators, will be required whenever non-aggressive attic access is required or whenever VCI or LV is sampled. Level C PPE using PAPR respirators will be required whenever aggressive attic access is required or until a successful NEA is completed indicating a downgrade to half face negative pressure respirators. The action level (the level at which PPE will be upgraded from Level D to Level C) for sampling activities is one-half the PEL (0.05 f/cc). Additionally, upgrade to level C PPE will also be based on the material sampled and at the discretion of the SSC. Personal air monitoring for particulates will be analyzed by laboratories accredited though the NVLAP. Laboratory results will be received less than 1 day after actual exposure to assist assessing sampling conditions and change PPE accordingly.

8.3.2 Particulates

Friable asbestos is anticipated to be encountered during sampling. Other unanticipated particulates, such as mineral wood, fiberglass, and other insulating materials, may be encountered in attic areas.

Particulate air monitoring is the process of measuring the fiber content of a known volume of air collected during a specific period of time. The acceptable procedure for airborne asbestos measurement for personal exposure monitoring is PCM using the OSHA reference method specified in Appendix A of 29 CFR 1926.1101. NIOSH Method 7400 is an equivalent and acceptable method for measuring airborne fiber levels in area samples. The NIOSH method will be used for initial employee exposure monitoring. The standard detection limit is <0.01 f/cc. If lower levels of detection are required, the sample volume and collection time period should be increased. Adjustments to sample volume and time should be selected to obtain a fiber density between 100 to 1,300 fibers/mm^2.

In both sampling methods above, any fiber with an aspect ratio (measure of length vs. width) of greater than 3 to 1 is counted as an asbestos fiber. In areas with significant amounts of fibers such as fiberglass, the PCM method may overestimate the number of asbestos fibers in the air, and thus the exposure to employees. In this circumstance, a more selective method of asbestos identification will be employed, as explained below.

The acceptable procedure for airborne asbestos measurement by transmission electron microscopy (TEM) is the method EPA specified in 40 CFR 763, Appendix A to Subpart E, Interim Transmission Electron Microscopy Analytical Methods. NIOSH method 7402 is the equivalent TEM method to 40 CFR 763, Appendix A to Subpart E. TEM sampling provides greater analytical sensitivity and can differentiate between asbestos and non-asbestos fibers. TEM analysis of employee exposure samples will be limited during the TAPE, only being conducted if PCM samples cannot be analyzed due to overloading from nuisance particulates, or when fibers must be differentiated because the PEL is exceeded. If such instances arise, samples may be reanalyzed by TEM using NIOSH Method 7402.

8.4 USE AND MAINTENANCE OF SURVEY EQUIPMENT

All personnel using field survey equipment must have experience or training in its operation, limitations, and maintenance. Before they are used on site, maintenance and internal or electronic calibration will be performed in accordance with manufacturer recommendations by personnel who are familiar with the devices. Repairs, maintenance, and internal or electronic calibration of these devices will be recorded in an equipment maintenance logbook. Results of routine calibration will be recorded on daily air sampling data sheets.

8.5 THERMAL STRESS MONITORING

Heat stress and cold stress are common and serious threats at hazardous waste sites. SWPs 6-15 and 6-16 discuss heat and cold stress and include monitoring methods appropriate for the season and location of work (see Appendix B). The SSC will ensure proper coordination of employees adhering to SWP 6-15 and 6-16.

9.0 SITE CONTROL

Site control is an essential component in HASP implementation. The following sections discuss measures and procedures for site control, such as on-site communications, site control zones, site access control, site safety inspections, and SWPs.

9.1 ON-SITE COMMUNICATIONS

Successful communication between field teams and personnel is essential. The following communication systems will be available during site activities:

- Cellular telephones or two-way radios

The hand signals listed below will be used by site personnel in emergency situations or when verbal communication is difficult.

Signal	Definition
Hands clutching throat	Out of air or cannot breathe
Hands on top of head	Need assistance
Thumbs up	Okay, I am all right, or I understand
Thumbs down	No or negative
Arms waving upright	Send backup support

Signal	Definition
Gripping partner’s wrist	Exit area immediately

9.2 SITE CONTROL ZONES

The following site control zones will be established for each property and work task.

9.2.1 Zone 1: Exclusion Zone

An exclusion zone includes areas where contamination is either known or likely to be present or, because of work activity, has the potential to cause harm to personnel. During the TAPE, these areas will typically be limited to attics and crawl spaces. The exclusion zone will be established before Tetra Tech employees access attic areas or crawl spaces to collect samples. During sampling procedures, the Tetra Tech field team will restrict building occupants and visitors from entering the exclusion zone. Work tasks that may require establishment of an exclusion zone include the following:

Task 1– Interior inspection of VCI and LV in attics and crawl spaces.

Exclusion zones will not be established during collection of soil samples outside the buildings. However, building occupants should be restricted from the immediate area during sampling procedures. Exclusion zones shall be established during aggressive and non-aggressive attic inspections, whereby building occupants are restricted from the attic access staging rooms during the inspection procedures.

9.2.2 Zone 2: Decontamination Zone

Decontamination zones will be established during the TAPE project, in locations such as at the base of ladders used to access attic spaces or outside of crawl space entrances. These areas will be covered with one layer of polyethylene sheeting during sampling in the exclusion zones. Personal decontamination will entail removing of protective garments after field crews descend from attic areas or leave crawl spaces. During aggressive attic inspection procedures staged from the interior of a building, decontamination zones will be confined inside the polyethylene staging chambers. Tetra Tech personnel will use disposable wet wipes and/or wet towels to wash respirators and exposed areas such as faces and hands. Sampling equipment will be decontaminated at the sample locations. Decontamination procedures will consist of a water rinse or damp rag cleaning of equipment after each sample collected.

The decontamination zone will contain facilities to decontaminate personnel and portable equipment. Equipment decontamination procedures are described in Section 10.0. All PPE and polyethylene sheeting will be place in disposal bags and sealed before Tetra Tech employees leave the decontamination zones. After personal and equipment decontamination are complete and polyethylene sheeting is removed, decontamination areas will be cleaned of debris and residue using appropriate HEPA vacuuming or wet cleaning procedures. Visitors, including building occupants, will not be permitted to enter the decontamination zone without proper qualifications and Tetra Tech SSC authorization.

9.2.3 Zone 3: Support Zone

A support zone may consist of any uncontaminated and non-hazardous part of the site, such as areas adjacent to decontamination zones at the base of ladders used to access attic spaces or outside of crawl space entrances. After the exclusion zone has been established, sampling procedures will immediately stop if visible suspect asbestos-contaminated debris is observed outside of the sampling or decontamination areas at any time during sampling. Debris and residue will be cleaned up using appropriate HEPA vacuuming or wet cleaning procedures before work recommences. Site visitors who do not meet training, medical surveillance and PPE requirements may enter the support zone upon approval by the Tetra Tech SSC unless visible suspect asbestos-contaminated debris is observed in the area.

9.3 SITE ACCESS CONTROL

The study area during this project will not be one stationary location. Access to private residences will be with the permission of the owner. Owners and occupants should be restricted from the immediate areas during sampling procedures. Typically, they should be asked to stay in adjacent rooms during sampling procedures.

9.4 SITE SAFETY INSPECTIONS

To maintain safe work areas and compliance with this HASP, the Tetra Tech SSC will conduct one site safety inspection for each month spent on-site. Results of the site safety inspections will be recorded on a Field Audit Checklist (Form AF-1 in Appendix A).

9.5 SAFE WORK PRACTICES

Various SWPs are applicable during the TAPE project. These SWPs are included in Appendix B of this HASP. The following SWPs apply to the site:

- SWP 6-1, General Safe Work Practices
- SWP 6-8, Safe Electrical Work Practices
- SWP 6-9, Fall Protection Practices
- SWP 6-10, Portable Ladder Safety
- SWP 6-15, Heat Stress
- SWP 6-16, Cold Stress
- SWP 6-27, Respirator Cleaning Procedures
- SWP 6-28, Safe Work Practices for Use of Respirators
- SWP 6-29, Respirator Qualitative Fit Testing Procedures

10.0 DECONTAMINATION

Decontamination is the process of removing or neutralizing contaminants on personnel or equipment. When properly conducted, decontamination procedures protect workers from contaminants that may have accumulated on PPE, tools, rental vehicles and other equipment. Proper decontamination also prevents transport of potentially harmful materials to uncontaminated areas. Personnel and equipment decontamination procedures are described in the following sections.

10.1 PERSONNEL DECONTAMINATION

Personnel decontamination at the site will be limited by using disposable PPE whenever possible and by wet wiping of faces and hands after sampling procedures. Any personnel decontamination procedures will follow guidance in the *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (NIOSH and others 1985). Personnel and PPE will be decontaminated with potable water or a mixture of detergent and water. Disposable cloths or wet wipes will be placed in sealable baggies pending disposal.

10.2 EQUIPMENT DECONTAMINATION

Decontamination of all sampling, PPE, and field monitoring equipment used during site activities will be required. Decontamination of sampling equipment will be conducted at the sample locations. Decontamination procedures will consist of a water rinse or damp rag cleaning of equipment after each sample collected. As part of Tetra Tech quality assurance and general health and safety procedures, the interior of all rental vehicles will also be HEPA vacuumed wet wiped bi-monthly to ensure cleanliness.

10.2.1 PPE and Monitoring Equipment

Used, disposable PPE will be collected in sealable containers and will be disposed of in accordance with procedures described in the project specific work plan. Personnel decontamination procedures may be modified as necessary while on site. All non-disposable PPE such as hard hats, respirators, and any exposed clothing will be washed at the end of each workday, or as necessary depending on working conditions, to remove all potential for asbestos contamination. Monitoring equipment used during sampling will be rinsed with water at the end of each workday, or as necessary to remove any contamination.

10.2.2 Sampling Equipment

Sampling equipment, such as stainless steel mixing bowls will be decontaminated before and after each use as described below:

- Decontamination procedures for sampling equipment will depend on the sampling location. In most sampling situations equipment will, be decontaminated by wiping down with damp cloths or rags. Soap and water may be necessary (but are not mandatory) when items are excessively dirty.
- Sampling equipment will be wiped down with disposable paper towels or be allowed to air-dry before the next use.

11.0 EMERGENCY RESPONSE PLANNING

This section describes emergency response planning procedures to be implemented for the site. This section is consistent with local, state, and Federal disaster and emergency management plans. The following sections discuss pre-emergency planning, personnel roles and lines of authority, emergency recognition and prevention, evacuation routes and procedures, emergency contacts and notifications, hospital route directions, emergency medical treatment procedures, protective equipment failure, fire or explosion, weather-related emergencies, spills or leaks, emergency equipment and facilities, and reporting.

11.1 PRE-EMERGENCY PLANNING

All on-site employees will be trained in and reminded of the provisions of Section 11.0, site communication systems, and site evacuation routes during the pre-work briefing and daily tailgate safety meetings. The Tetra Tech SSC will review the emergency response provisions on a regular basis and they will be revised, if necessary, to make certain that they are adequate and consistent with prevailing site conditions.

11.2 PERSONNEL ROLES AND LINES OF AUTHORITY

The Tetra Tech SSC has primary responsibility for responding to and correcting emergencies and for taking appropriate measures to maintain the safety of site personnel and the public. Possible actions may include evacuation of personnel from the site area. The SSC is also responsible for ensuring that corrective measures have been implemented, appropriate authorities have been notified, and follow-up reports have been completed.

Individual subcontractors are required to cooperate with the SSC, within the parameters of their scopes of work.

Personnel are required to report all injuries, illnesses, spills, fires, and property damage to the SSC immediately. The SSC must be notified of any on-site emergencies and is responsible for following the appropriate emergency procedures described in this section.

11.3 EMERGENCY RECOGNITION AND PREVENTION

Table 4-1 lists potential on-site chemical hazards, and Table 4-2 provides information on the hazards associated with the various tasks planned for the site. On-site personnel will be made familiar with this information and with techniques of hazard recognition through pre-work training and site-specific briefings.

11.4 EVACUATION ROUTES AND PROCEDURES

In the event of an emergency that necessitates evacuation of a work task area or the site, the Tetra Tech SSC will contact all nearby personnel using the on-site communication systems discussed in Section 9.1 to advise the personnel of the emergency. The personnel will proceed along site roads to a safe distance upwind from the source of the hazard. The personnel will remain in that area until the SSC or an authorized individual provides further instructions.

11.5 EMERGENCY CONTACTS AND NOTIFICATIONS

The emergency information preceding Section 1.0 of this HASP provides names and telephone numbers of emergency contact personnel. This page must be posted on site or must be readily available at all times. In the event of a medical emergency, personnel will notify the appropriate emergency organization and will take direction from the Tetra Tech SSC. The project team will follow procedures discussed in Section 11.9 or 11.11.

11.6 HOSPITAL ROUTE DIRECTIONS

Before site activities begin, Tetra Tech personnel will conduct a pre-emergency hospital run to familiarize themselves with the route to the local hospital. A map showing the hospital route is provided in the emergency information preceding Section 1.0 of this HASP.

11.7 EMERGENCY MEDICAL TREATMENT PROCEDURES

A person who becomes ill or injured during work may require decontamination. If the illness or injury is minor, any decontamination necessary will be completed and first aid should be administered before the patient is transported. If the patient's condition is serious, partial decontamination will be completed (such as complete disrobing of the person and redressing the person in clean coveralls or wrapping in a blanket). First aid should be administered until an ambulance or paramedics arrive. All injuries and illnesses must be reported immediately to the Tetra Tech project manager and HSR.

11.8 PROTECTIVE EQUIPMENT FAILURE

If any worker in the exclusion zone experiences a failure of protective equipment (either engineering controls or PPE) that affects his or her personal protection, the worker and all coworkers will immediately leave the exclusion zone. Re-entry to the exclusion zone will not be permitted until: (1) the protective equipment has been repaired or replaced, (2) the cause of the equipment failure has been determined, and (3) the equipment failure is no longer considered to be a threat.

11.9 FIRE OR EXPLOSION

In the event of a fire or explosion on site, fire department will be immediately summoned. The Tetra Tech SSC or a site representative will advise the fire department of the location and nature of any hazardous materials involved. Appropriate provisions of Section 11.0 will be implemented by site personnel.

11.10 WEATHER-RELATED EMERGENCIES

Work will not be conducted during severe weather conditions, including high-speed winds or lightning. In the event of severe weather, field personnel will stop work, secure and lower all equipment, and leave the site.

Thermal stress caused by excessive heat or cold may occur as a result of extreme temperatures, workload, or the PPE used. Heat and cold stress treatment will be administered as described in SWPs 6-15 and 6-16.

11.11 EMERGENCY EQUIPMENT AND FACILITIES

The following emergency equipment will be available on site:

- First aid kit
- Fire extinguisher
- Site telephones, depending on location
- Mobile telephone
- Confined-space entry equipment, as necessary
- Fall protection equipment, as necessary

11.12 REPORTING

All emergencies require follow-up and reporting. Appendix A includes the Tetra Tech Incident Report (Form IR). This report must be completed and submitted to the Tetra Tech project manager and Regional Safety Officer (RSO) within 24 hours of an emergency. The project manager will review the report and then forward it to the Tetra Tech HSR for review. The report must include proposed actions to prevent similar incidents from occurring. The HSR must be fully informed of the corrective action process so that he may implement applicable elements of the process at other sites.

REFERENCES

American Conference of Governmental Industrial Hygienists (ACGIH). "Threshold Limit Values and Biological Exposure Indices for 1998." Latest edition.

National Institute for Occupational Safety and Health (NIOSH) and others. 1985. *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*. October.

NIOSH. 1997. "Pocket Guide to Chemical Hazards." U.S. Department of Health and Human Services. U.S. Government Printing Office. Washington, DC. June.

Tetra Tech, Inc. 1999. "Health and Safety Manual."

SITE SPECIFIC HEALTH AND SAFETY PLAN

APPENDIX A

TETRA TECH FORMS

(11 Sheets)

- Compliance Agreement (Form HSP-4)
- Daily Tailgate Safety Meeting (Form HST-2)
- Daily Site Log (Form SSC-1)
- Accident and Illness Investigation Report (Form IR, IR-A, IR-B, IR-C, HIPAA Form)
- Field Audit Checklist (Form AF-1)
- Air Sampling Data Sheet (Stationary and Personal Air Sampling)

TETRA TECH, INC.

DAILY TAILGATE SAFETY MEETING FORM

Date: ______________ Time: ________________ Project No.: ________________

Client: __________________________________ Site Location: __________________________

Site Activities Planned for Today: ____

____

Safety Topics Discussed
Protective clothing and equipment:
Chemical hazards:
Physical hazards:
Environmental and biohazards:
Equipment hazards:
Decontamination procedures:
Other:
Review of emergency procedures:
Employee Questions or Comments:

TETRA TECH, INC.

DAILY TAILGATE SAFETY MEETING FORM (Continued)

Attendees	
Printed Name	**Signature**

Meeting Conducted by:

Name ______________________ Title ______________________

Signature ______________________

TETRA TECH, INC.

HEALTH AND SAFETY PLAN COMPLIANCE AGREEMENT

Project Name: ____

Project Number: ____

I have read and understand the health and safety plan indicated above and agree to comply with all of its provisions. I understand that I could be prohibited from working on the project for violating any of the safety requirements specified in the plan.

Name	Signature	Employer	Date

TETRA TECH, INC.

ACCIDENT AND ILLNESS INVESTIGATION REPORT

To: ______________________________
Subsidiary Health and Safety Representative

Cc: ______________________________
Workers Compensation Administrator

Project name: ______________________________

Project number. ______________________________

Prepared by: ______________________________

Position: ______________________________

Office: ______________________________

Telephone number: ______________________________

Fax number: ______________________________

Information Regarding Injured or Ill Employee

Name: ______________________________

Home address: ______________________________

____

Home telephone number: ______________________________

Occupation (regular job title): ______________________________

Department: ______________________________

Office: ______________________________

Gender: M ☐ F ☐ No. of dependents: __________

Marital status: ______________________________

Date of birth: ______________________________

Social Security Number: ______________________________

Date of Accident: ______________________________

Time Employee Began Work: ______________________________

Time of Accident: ______________ a.m. ☐ p.m. ☐

☐ Check if time cannot be determined

Location of Accident

Street address: ______________________________

City, state, and zip code: ______________________________

County: ______________________________

Was place of accident or exposure on employer's premises? Yes ☐ No ☐

Information About the Case

What was the employee doing just before the incident occurred?: Describe the activity, as well as the tools, equipment, or material the employee was using. Be specific. Examples: "climbing a ladder while carrying roofing materials"; "spraying chlorine from hand sprayer"; "daily computer key-entry."

What Happened?: Describe how the injury occurred. Examples: "When ladder slipped on wet floor, worker fell 20 feet"; "Worker was sprayed with chlorine when gasket broke during replacement"; "Worker developed soreness in wrist over time."

This form contains information relating to employee health and must be used in a manner that protects the confidentiality of the employee to the extent possible while the information is being used for occupational safety and health purposes.

TETRA TECH, INC.

ACCIDENT AND ILLNESS INVESTIGATION REPORT (Continued)

Information About the Case (Continued)

What was the injury or illness? Describe the part of the body that was affected and how it was affected; be more specific than "hurt," "pain," or "sore." Examples "strained back"; "chemical burn, right hand"; "carpal tunnel syndrome, left wrist."

Describe the Object or Substance which Directly Harmed the Employee: Examples: "concrete floor"; "chlorine"; "radial arm saw." If this question does not apply to the incident, enter a NA.

Did the employee die? Yes ☐ No ☐ Date of death: ______________________________

Was employee performing regular job duties? Yes ☐ No ☐

Was safety equipment provided? Yes ☐ No ☐ Was safety equipment used? Yes ☐ No ☐

Note: Attach any police reports or related diagrams to this accident report.

Witness(es):

Name: ____

Company: ____

Street address: ____

City: ______________________ State:____________ Zip code:______________

Telephone number: ____

Name: ____

Company: ____

Street address: ____

City: ______________________ State:____________ Zip code:______________

Telephone number: ____

Medical Treatment Required? ☐ Yes ☐ No ☐ First Aid only

Name of physician or health care professional: ______________________________

If treatment was provided away from the work-site, where was it given?

Facility name: ____

Street address: ____

City: ______________________ State:____________ Zip code:______________

Telephone number: ____

Was the employee treated in an emergency room? ☐ Yes ☐ No

Was the employee hospitalized overnight as an in-patient? ☐ Yes ☐ No

This form contains information relating to employee health and must be used in a manner that protects the confidentiality of the employee to the extent possible while the information is being used for occupational safety and health purposes.

TETRA TECH, INC.

ACCIDENT AND ILLNESS INVESTIGATION REPORT (Continued)

Corrective Action(s) Taken by Unit Reporting the Accident: **Corrective Action Still to be Taken (by whom and when):**
Name of Tetra Tech employee the injury or illness was first reported to: ____________________________ **Date of Report:** ____________________________ **Time of Report:** ____________________________

I have reviewed this investigation report and agree, to the best of my recollection, with its contents.

Printed Name of Injured Employee	Telephone Number
Signature of Injured Employee	Datee

The signatures provided below indicate that appropriate personnel have been notified of the incident.

Title	Printed Name	Signature	Telephone Number	Date
Project or Office Manager				
Site Safety Coordinator				

This form contains information relating to employee health and must be used in a manner that protects the confidentiality of the employee to the extent possible while the information is being used for occupational safety and health purposes.

TETRA TECH, INC.

ACCIDENT AND ILLNESS INVESTIGATION REPORT (Continued)

To be completed by the Subsidiary Safety and Health Representative:

Classification of Incident:

☐ Injury ☐ Illness

Result of Incident:

☐ First Aid Only

☐ Days Away From Work

☐ Remained at Work but Incident Resulted in Job Transfer or Work Restriction

☐ Incident Involved Days Away and Job Transfer or Work Restriction

☐ Medical Treatment Only

No. of Days Away From Work ______________________________

Date Employee Left Work ______________________________

Date Employee Returned to Work ______________________________

No. of Days Placed on Restriction or Job Transfer: ______________________________

OSHA Recordable Case Number ______________________________

To be completed by Human Resources:

SSN: ______________________________

Date of hire: ____________________ Hire date in current job: ____________________

Wage information: $ __________ per ☐ Hour ☐ Day ☐ Week ☐ Month

Position at time of hire: ______________________________

Current position: ____________________ Shift hours: ____________________

State in which employee was hired: ______________________________

Status: ☐ Full-time ☐ Part-time Hours per week: ________ Days per week: ________

Temporary job end date: ______________________________

To be completed during report to workers' compensation carrier:

Date reported: ____________________ Reported by: ____________________

Confirmation number: ______________________________

Name of contact: ______________________________

Field office of claims adjuster: ______________________________

This form contains information relating to employee health and must be used in a manner that protects the confidentiality of the employee to the extent possible while the information is being used for occupational safety and health purposes.

TETRA TECH, INC.

FIELD AUDIT CHECKLIST

Project Name: ________________________________ Project No.: _______________________

Field Location: _______________________________ Completed by: _____________________

Project Manager: ________________________ Site Safety Coordinator: _____________________

General Items		In Compliance?		
Health and Safety Plan Requirements		Yes	No	NA
1	Approved health and safety plan (HASP) on site or available			
2	Names of on-site personnel recorded in field logbook or daily log			
3	HASP compliance agreement form signed by all on-site personnel			
4	Material Safety Data Sheets on site or available			
5	Designated site safety coordinator present			
6	Daily tailgate safety meetings conducted and documented			
7	On-site personnel meet HASP requirements for medical examinations, fit testing, and training (including subcontractors)			
8	Compliance with specified safe work practices			
9	Documentation of training, medical examinations, and fit tests available from employer			
10	Exclusion, decontamination, and support zones delineated and enforced			
11	Windsock or ribbons in place to indicate wind direction			
12	Illness and injury prevention program reports completed (California only)			
Emergency Planning				
13	Emergency telephone numbers posted			
14	Emergency route to hospital posted			
15	Local emergency providers notified of site activities			
16	Adequate safety equipment inventory available			
17	First aid provider and supplies available			
18	Eyewash stations in place			
Air Monitoring				
19	Monitoring equipment specified in HASP available and in working order			
20	Monitoring equipment calibrated and calibration records available			
21	Personnel know how to operate monitoring equipment and equipment manuals available on site			
23	Environmental and personnel monitoring performed as specified in HASP			

TETRA TECH, INC.

FIELD AUDIT CHECKLIST (Continued)

Safety Items		In Compliance?		
Personal Protection		Yes	No	NA
1	Splash suit			
2	Chemical protective clothing			
3	Safety glasses or goggles			
4	Gloves			
5	Overboots			
6	Hard hat			
7	Dust mask			
8	Hearing protection			
9	Respirator			
Instrumentation				
10	Combustible gas meter			
11	Oxygen meter			
12	Organic vapor analyzer			
Supplies				
13	Decontamination equipment and supplies			
14	Fire extinguishers			
15	Spill cleanup supplies			
Corrective Action Taken During Audit:				
Corrective Action Still Needed:				

Note: NA = Not applicable

Auditor's Signature

Site Safety Coordinator's Signature

Date

AIR SAMPLING ANALYSIS REQUEST FORM
CHAIN OF CUSTODY

Tetra Tech EM, Inc.
Power Block Building
7 West 6th Avenue, Suite 612
Helena, Montana 59601
Office # (406) 442-5588
Fax # (406) 442-7182

Project Name:	Troy Asbestos Property Evaluation (TAPE)
Project No:	
Collected By:	
Turn-Around Time1:	

Tetra Tech Sample #	Lab I.D.#	Date Collected	Sample Category2	Sample Type3	Sample Medium4	Sample Pore Size5	Time On / Time Off / Total Minutes	Flow Rate-Start / Flow Rate-Stop / Total Volume	Sample Location(s) 6	Stationary / Personal	Activity7
							/ / 	/ / 			
							/ / 	/ / 			
							/ / 	/ / 			
							/ / 	/ / 			
							/ / 	/ / 			
							/ / 	/ / 			

Special Instructions/Comments:____

*** Contact Person**:_______________________ *** Contact #**: ( ) ____________ **Analytical Laboratory**:) ________________

Samples Relinquished By:_______________Date (/ /) Time (:) Samples Received By:_________________Date (/ /) Time (:)
Samples Relinquished By: _______________Date (/ /) Time (:) Samples Received By:_________________Date (/ /) Time (:)
Samples Relinquished By: _______________Date (/ /) Time (:) Samples Received By:_________________Date (/ /) Time (:)

1) RUSH, 4HR, 8HR, 12HR, 24HR, Other. 2) (P) = Perimeter, (E) = Excursion, (D) = Duration, (C) = Clearance, (B) = Background, (O) = Other. 3) PCM (AHERA) (NIOSH 7400), TEM (AHERA) (NIOSH 7402) (Yamate 2), AA, Non-Viable Fungi, Nuisance (Respirable) Dust, TVOC, Metals, Other.
4) MCE, PVC, Matched Weight, Other. 5) 0.45µm (TEM), 0.8µm (PCM), Other. 6) Property address(s) and building number(s). 7) Stationary or Personal 8) Field sampling, data entry, office

TETRA TECH, INC.

DAILY SITE LOG

Site Name:_______________________________________ Date: ___________________________

Name (print)	Company	Time	
		In	Out

Comments:

____

____

____

SITE SPECIFIC HEALTH AND SAFETY PLAN

APPENDIX B

SAFE WORK PRACTICES

(38 Sheets)

- SWP 6-1 General Safe Work Practices
- SWP 6-9 Fall Protection Practices
- SWP 6-10 Portable Ladder Safety
- SWP 6-15 Heat Stress
- SWP 6-16 Cold Stress
- SWP 6-27 Respirator Cleaning Procedures
- SWP 6-28 Safe Work Practices for Use of Respirators
- SWP 6-29 Respirator for Qualitative Fit Testing Procedures

TETRA TECH, INC.

HEALTH AND SAFETY MANUAL

VOLUME III

SAFE WORK PRACTICES (SWP)

SAFE WORK PRACTICES FOR USE OF AIR PURIFYING RESPIRATORS

SWP NO.: 6-28

ISSUE DATE: FEBRUARY 1999

REVISION: 0

SAFE WORK PRACTICES FOR USE OF RESPIRATORS

This safe work practice (SWP) was developed to ensure the proper use of respirators in routine and foreseeable emergency situations. The SWP supplements Document Control No. 2-6, "Respiratory Protection Program." This SWP shall be included as an attachment to the site-specific health and safety plan (HASP) for projects for which respirator use is planned or is a contingency.

1.0 APPLICABILITY

This SWP shall apply to any project that involves use of air purifying respirators and shall not be used for situations involving the use of supplied air systems such as self-contained breathing apparatuses and air-line apparatuses.

2.0 ROUTINE RESPIRATOR USE PROCEDURES

The procedures below apply to the routine use of air purifying respirators.

- Respirators shall not be issued to or worn by individuals when conditions prevent valve function or a good facial seal. These conditions may include but are not limited to facial hair, such as the growth of beard, sideburns, or excessive mustaches, and possibly the wearing of corrective eyeglasses.

- If spectacles, goggles, face shields, or welding helmets must be worn with a facepiece, they will be worn so as not to adversely affect the seal of the facepiece to the face.

- For all tight-fitting respirators, a positive and negative pressure seal check shall be performed each time the respirator is donned. Seal checks shall be performed as follow:

  – *Negative pressure check:* Close off the inlet opening of the canister or cartridge(s) by covering it with the palm of the hand(s), inhale gently so that the facepiece collapses slightly, and hold the breath for 10 seconds. If the facepiece remains in its slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is satisfactory.

  – *Positive pressure check*: Close off the exhalation valve and exhale gently into the facepiece. The face fit is considered satisfactory if a slight positive pressure can be built up inside the facepiece without any evidence of outward leakage of air at the seal. The exhalation valve cover may have to be removed to perform this procedure.

  - *Manufacturer's recommended seal check*: If the respirator manufacturer recommends specific procedures for performing a user seal check, these procedures may be used instead of the negative and positive pressure checks.

- Work areas must be monitored for conditions that may adversely affect the effectiveness of respiratory protection. Employees may leave the work area where respirators are required under the following conditions:

  - To wash the face and respirator facepieces as necessary to prevent eye or skin irritation
  - If vapor or gas breakthrough, changes in breathing resistance, or leakage of the facepiece is detected
  - To replace the respirator or the filter, cartridge, or canister elements
  - If established monitoring instrument action levels are exceeded
  - For any other criteria as established in a project specific health and safety plan

3.0 RESPIRATOR USE DURING EMERGENCY SITUATIONS

Emergency situations may arise during the wearing of respiratory protection. These situations could include medical emergency, respirator failure, fire, chemical spills or leaks, and other events that pose an immediate risk. Procedures for respirator use during emergency situations are summarized below.

- When an emergency situation arises that creates or has the potential to create immediately dangerous to life and health (IDLH) conditions, the work environment shall be evacuated immediately and shall not be reentered by employees without suitable protective gear.
- Work environments with the potential for the development of atmospheres that may present IDLH conditions shall only be entered by employees using the buddy system.
- When an emergency situation arises that includes physical hazards that may interfere with the proper use of respiratory protection, the work environment shall be evacuated.
- Under no circumstances shall respirator users remove facepieces in hazardous atmospheres. In the event of respirator malfunction, users should leave the hazardous environment immediately and proceed to a known safe location before removal of the facepiece.
- Episodes of respirator failure shall be thoroughly investigated before work activities begin again. The investigation shall include re-evaluation of work area atmospheric

conditions, review of the respirator selection criteria and service life calculations, and an evaluation of the working conditions under which respirator failure occurred.

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VOLUME III

SAFE WORK PRACTICES (SWP)

RESPIRATOR CLEANING PROCEDURES

SWP NO.: 6-27

ISSUE DATE: FEBRUARY 1999

REVISION: 0

RESPIRATOR CLEANING PROCEDURES

This safe work practice (SWP) provides guidelines for proper and thorough cleaning of respiratory protection equipment. The Occupational Safety and Health Administration (OSHA) regulates the use of respiratory protection for general industry in Title 29 of the *Code of Federal Regulations* (CFR) Part 1910.134, "Respiratory Protection." Appendix B-2 of the standard outlines mandatory requirements for respirator cleaning and is used as the basis for this SWP. This SWP supplements Document Control No. 2-6, "Respiratory Protection Program." It provides specific respirator cleaning and disinfection procedures and shall be included as an attachment to the site-specific health and safety plan for projects for which respirator use is planned or is a contingency.

1.0 APPLICABILITY

This SWP shall apply to any project that involves use of respirators with reusable facepieces.

Respirators shall be cleaned and disinfected as discussed below.

- Respirators issued for the exclusive use of an employee shall be cleaned and disinfected as often as necessary to be maintained in a sanitary condition.
- Respirators issued to more than one employee shall be cleaned and disinfected before being worn by different individuals.
- Respirators maintained for emergency use shall be cleaned and disinfected after each use.
- Respirators used in fit testing and training shall be cleaned and disinfected after each use.

2.0 CLEANING AND DISINFECTION PROCEDURES

Mandatory respirator cleaning procedures as defined in 29 CFR Part 1910.134, Appendix B-2, are listed below. All wash and rinse water should be warm, with a maximum temperature of 110 °F (43 °C).

1. Remove filters, cartridges, or canisters. Disassemble facepieces by removing speaking diaphragms, demand and pressure-demand valve assemblies, hoses, and any other components as recommended by the manufacturer. Discard or repair any defective parts.

2. Wash components in warm water with a mild detergent or with a cleaner recommended by the manufacturer. A stiff bristle (not wire) brush may be used to facilitate the removal of dirt.

3. Rinse components thoroughly in clean, warm, preferably running water. Drain all components.

4. When the cleaner does not contain a disinfecting agent, respirator components should be immersed for 2 minutes in one of the following:

   - Hypochlorite solution [50 parts per million (ppm) of chlorine] made by adding approximately one milliliter of laundry bleach to 1 liter of warm water

   - Aqueous solution of iodine [50 ppm iodine made by adding approximately 0.8 milliliter of tincture of iodine (6 to 8 grams ammonium and/or potassium iodide per 100 cubic centimeters of 45 percent alcohol) to 1 liter of warm water]

   - Other commercially available cleansers of equivalent disinfectant quality when used as directed if their use is recommended or approved by the respirator manufacturer

5. Rinse components thoroughly in clean, warm, preferably running water. Drain all components. The importance of thorough rinsing cannot be over emphasized. Detergents or disinfectants that dry on facepieces may cause dermatitis. In addition, some disinfectants may cause deterioration of rubber or corrosion of metal parts if not completely removed.

6. Components should be air-dried or hand-dried with a clean, lint-free cloth.

7. Reassemble the facepiece. Replace filters, cartridges, and canisters prior to next use.

8. Test the respirator to ensure that all components work properly.

9. Place the respirator in a clean bag and seal for storage.

Depending on work conditions, respirator facial sealing surfaces may need periodic cleaning during the course of daily use. Cleaning of the facial sealing surface during work breaks can reduce the chance of facial irritation caused by sweat, natural skin oil, or irritating materials that may have deposited on the facepiece. Facial sealing surfaces can be cleaned using disinfectant wipes soaked in isopropyl alcohol or benzalkonium chloride. After use of the disinfectant wipe, the sealing surface should air dry or be dried thoroughly using paper towels or tissues.

TETRA TECH, INC.

HEALTH AND SAFETY MANUAL

VOLUME III

SAFE WORK PRACTICES (SWP)

COLD STRESS

SWP NO.: 6-16

ISSUE DATE: JULY 1998

REVISION NO.: 1

COLD STRESS

This safe work practices (SWP) describes situations where cold stress is likely to occur and discusses procedures for the prevention and treatment of cold-related injuries and illnesses. Cold conditions may present health risks to employees during field activities. The two primary factors that influence the risk potential for cold stress are temperature and wind velocity. Wetness can also contribute to cold stress. Other factors that increase susceptibility to cold stress include age (very young or old), smoking, alcohol consumption, fatigue, and wet clothing. Hypothermia can occur at temperatures above freezing if the individual has on wet or damp clothing or is immersed in cold water. The combined effect of temperature and wind can be evaluated using a wind chill index as shown in Table 1.

Bare flesh and body extremities that have high surface area-to-volume ratios such as fingers, toes, and ears are most susceptible to wind chill or extremely low ambient temperatures. Because cold stress can create the potential for serious injury or death, employees must be familiar with the signs and symptoms and various treatments for each form of cold stress. Table 2 provides information on frostbite and hypothermia, the two most common forms of cold-related injuries.

Training is an essential component of cold stress prevention. Employees are instructed to recognize and treat cold-related injuries during 8-hour health and safety refresher and first aid training courses. When working in cold environments, specific steps should be taken to lessen the chances of cold-related injuries. These include the following:

- Protecting of exposed skin surfaces with appropriate clothing (such as face masks, handwear, and footwear) that insulates, stays dry, and blocks wind
- Shielding the work area with windbreaks to reduce the cooling effects of wind
- Providing equipment for keeping workers' hands warm by including warm air jets and radiant heaters in addition to insulated gloves
- Using adequate insulating clothing to maintain a body core temperature of above 36 °C
- Providing extra insulating clothing on site

TABLE 1

COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED AS EQUIVALENT TEMPERATURE

Estimated Wind Speed (in miles per hour - mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°F)											
CALM	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148

(Wind speeds greater than 40 mph have little additional effect.)	*LITTLE DANGER* in less than 1 hour with dry skin; maximum danger from false sense of security	*INCREASING DANGER* from freezing of exposed flesh within 1 minute	*GREAT DANGER* that flesh may freeze within 30 seconds

Trench foot may occur at any point on this chart.

Source: Modified from American Conference of Governmental Industrial Hygienists. 1997. "Threshold Limit Values for Chemical Substances and Physical Agents."

TABLE 2

COLD STRESS CONDITIONS

Condition	Causes	Signs and Symptoms	Treatment
Frostbite	Freezing of body tissue, usually the nose, ears, chin, cheeks, fingers, or toes	• Pain in affected area that later goes away • Area feels cold and numb • Incipient frostbite (frostnip) - skin is blanched or whitened and feels hard on the surface • Moderate frostbite - large blisters • Deep frostbite - tissues are cold, pale, and hard	• Move affected worker to a warm area • Immerse affected body part in warm (100 to 105 °F) water—not hot! • Handle affected area gently; do not rub • After warming, bandage loosely and seek immediate medical treatment
Hypothermia	Exposure to freezing or rapidly dropping temperatures	• Shivering, dizziness, numbness, weakness, impaired judgment, and impaired vision • Apathy, listlessness, or sleepiness • Loss of consciousness • Decreased pulse and breathing rates • Death	• Immediately move affected person to warm area • Remove all wet clothing and redress with loose, dry clothes • Provide warm, sweet drinks or soup (only if conscious) • Seek immediate medical treatment

- Reducing the duration of exposure to cold
- Changing wet or damp clothing as soon as possible

During periods of extreme cold (10 °F or less) workers should use the buddy system to ensure constant protective observation.

Specific monitoring criteria are not established for cold stress. However, employees should be thoroughly cognizant of the signs and symptoms of frostbite and hypothermia (see Table 1) in themselves as well as in coworkers. All instances of cold stress should be reported to the site safety coordinator. Work schedules may be adjusted and warm-up regimes imposed as needed to deal with temperature and wind conditions.

TETRA TECH, INC.

HEALTH AND SAFETY MANUAL

VOLUME III

SAFE WORK PRACTICES (SWP)

HEAT STRESS

SWP NO.: 6-15

ISSUE DATE: JULY 1998

REVISION NO.: 1

HEAT STRESS

This safe work practice (SWP) describes situations where heat stress is likely to occur and provides procedures for the prevention and treatment of heat-related injuries and illnesses. Wearing personal protective equipment (PPE), especially during warm weather, puts employees at considerable risk of developing heat-related illness. Health effects from heat stress may range from transient heat fatigue or rashes to serious illness or death.

Many factors contribute to heat stress, including PPE, ambient temperature and humidity, workload, and the physical condition of the employee, as well as predisposing medical conditions. However, the primary factors are elevated ambient temperatures in combination with fluid loss. Because heat stress is one of the more common health concerns that may be encountered during field activities, employees must be familiar with the signs, symptoms, and various treatment methods of each form of heat stress. Heat stroke is the most serious heat-related illness—it is a threat to life and has a 20 percent mortality rate. Direct exposure to sun, poor air circulation, poor physical condition, and advanced age directly affect the tendency to heat stroke. Table 1 lists the most serious heat conditions, their causes, signs and symptoms, and treatment.

Training is an important component of heat stress prevention. Employees are instructed to recognize and treat heat-related illnesses during 8-hour health and safety refresher and first aid training courses. When working in hot environments, specific steps should be taken to lessen the chances of heat-related illnesses. These include the following:

- Ensuring that all employees drink plenty of fluids (Gatorade® or its equivalent)
- Ensuring that frequent breaks are scheduled so overheating does not occur
- Revising work schedules, when necessary, to take advantage of the cooler parts of the day (such as working from 5:00 a.m. to 11:00 a.m. and 6:00 p.m. to nightfall).

When PPE must be worn (especially Levels A and B), suggested guidelines relating to ambient temperature and maximum wearing time per excursion are as shown in Table 2.

TABLE 1

HEAT STRESS CONDITIONS

Condition	Causes	Signs and Symptoms	Treatment
Heat cramps	Fluid loss and electrolyte imbalance from dehydration	• Painful muscle cramps, especially in legs and abdomen • Faintness • Profuse perspiration	• Move affected worker to cool location • Provide sips of liquid such as Gatorade® • Stretch cramped muscles • Transport affected worker to hospital if condition worsens
Heat Exhaustion	Blood transport to skin to dissipate excessive body heat, resulting in blood pooling in the skin with inadequate return to the heart	• Weak pulse • Rapid and shallow breathing • General weakness • Pale, clammy skin • Profuse perspiration • Dizziness • Unconsciousness	• Move affected worker to cool area • Remove as much clothing as possible • Provide sips of cool liquid or Gatorade® (only if conscious) • Fan the person but do not overcool or chill • Treat for shock • Transport to hospital if condition worsens
Heat Stroke	Life threatening condition from profound disturbance of body's heat-regulating mechanism	• Dry, hot, and flushed skin • Constricted pupils • Early loss of consciousness • Rapid pulse • Deep breathing at first, and then shallow breathing • Muscle twitching leading to convulsions • Body temperature reaching 105 or 106 °F or higher	• Immediately transport victim to medical facility • Move victim to cool area • Remove as much clothing as possible • Reduce body heat promptly by dousing with water or wrapping in wet cloth • Place ice packs under arms, around neck, at ankles, and wherever blood vessels are close to skin surface • Protect patient during convulsions

TABLE 2

SUGGESTED GUIDELINES WHEN WEARING PPE

Ambient Temperature	Maximum PPE Wearing Time per Excursion
Above 90 °F	15 minutes
85 to 90 °F	30 minutes
80 to 85 °F	60 minutes
70 to 80 °F	90 minutes
60 to 70 °F	120 minutes
50 to 60 °F	180 minutes

Source: National Institute for Occupational Safety and Health (NIOSH). 1985. Memorandum Regarding Recommended Personal Protective Equipment Wearing Times at Different Temperatures. From Austin Henschel. To Sheldon Rabinovitz. June 20.

To monitor the level of an employee’s heat stress, the following should be measured:

- Heart Rate: Count the radial (wrist) pulse during a 30-second period as early as possible in the rest period; if heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same.

  If the heart rate still exceeds 110 beats per minute at the next period, shorten the following work cycle by one-third.

- Oral Temperature: Use a clinical thermometer (3 minutes under the tongue) to measure the oral temperature at the end of the work period. If oral temperature exceeds 99.6 °F (37.6 °C), shorten the next work cycle by one-third without changing the rest period. If oral temperature still exceeds 99.6 °F at the beginning of the next rest period, shorten the following work cycle by one-third. Do not permit a worker to wear impermeable PPE when his or her oral temperature exceeds 100.6 °F (38.1 °C).

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SAFE WORK PRACTICES (SWP)

PORTABLE LADDER SAFETY

SWP NO.: 6-10

ISSUE DATE: JULY 1998

REVISION NO.: 1

PORTABLE LADDER SAFETY

This safe work practice (SWP) applies to portable ladders only. Fixed ladder systems shall be used when regular access is required such as for entering storage tanks and raised work platforms. These SWPs follow the regulatory requirements for ladders as found in Title 29 of the *Code of Federal Regulations* (CFR) Part 1926.1053. Procedures to ensure portable ladder safety are listed below.

- Ladders should be maintained in good condition at all times. Damaged ladders shall be withdrawn from service immediately.
- Ladders should be inspected regularly and removed from service and repaired or discarded if defective.
- Rungs should have slip-resistant surfaces and be kept free of grease and oil.
- Tops and pail shelves of portable stepladders should not be used as steps.
- Rung and cleat ladders should be placed so that the horizontal distance from the top support to the foot of the ladder is one-quarter of the working length of the ladder.
- Ladders should not be placed in front of doorways, drives, or passageways.
- Ladders should not be placed on boxes, barrels, or other unstable bases to add height.
- Employees should always face the ladder during ascent or descent.
- Metal ladders should not be used in areas with the potential for contact with electric circuits.
- Ladder side rails shall extend at least 3 feet above the upper landing surface to which the ladder is used to access.
- Ladder shall be used only on stable and level surfaces. Do not use ladders on slippery surfaces.

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SAFE WORK PRACTICES (SWP)

FALL PROTECTION PRACTICES

SWP NO.: 6-9

ISSUE DATE: JULY 1998

REVISION NO.: 1

FALL PROTECTION PRACTICES

This safe work practice (SWP) presents general guidelines for basic fall protection when working in elevated areas. Continuous elevated work or elevated construction work will require detailed procedures included in a site-specific health and safety plan. SWP No. 6-10, “Portable Ladder Safety,” should also be consulted. During elevated work, the precautions below must be taken.

- All fall hazards should be identified at work sites with the potential for elevated work. Once an elevated fall hazard has been recognized, an appropriate control measure must be selected. Priority should be given to elimination of the fall hazard over the use of fall protection equipment.
- Approved safety harnesses and lanyards shall be worn by employees whose work exposes them to falls of greater than 6 feet.
- Lanyards should be anchored at a level no lower than the employee’s waist to limit the fall distance to a maximum of 4 feet and to not allow the employee to contact the next lower work level, where practical.
- All fall protection devices should be used only in accordance with manufacturer’s recommendations.
- All fall protection devices shall be inspected daily before use.
- Any lifeline, harness, or lanyard actually subjected to in-service loading (a fall) should be immediately removed from service and not used again for employee fall protection.
- Anchor points and lanyards capable of supporting a minimum dead weight of 5,400 pounds should be used.
- Employees who are required to wear fall protection should be trained in the use of the equipment, as well as in fall protection work practices.

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SAFE WORK PRACTICES (SWP)

GENERAL SAFE WORK PRACTICES

SWP NO.: 6-1

ISSUE DATE: JULY 1998

REVISION NO.: 1

GENERAL SAFE WORK PRACTICES

To prevent injuries and adverse health effects, the following general safe work practices (SWP) are to be followed when conducting work involving known and unknown site hazards. These SWPs establish a pattern of general precautions and measures for reducing risks associated with hazardous site operations. This list is not inclusive and may be amended as necessary.

- Do not eat, drink, chew gum or tobacco, take medication, or smoke in contaminated or potentially contaminated areas or where the possibility for the transfer of contamination exists.
- Wash hands and face thoroughly upon leaving a contaminated or suspected contaminated area. A thorough shower and washing must be conducted as soon as possible if excessive skin contamination occurs.
- Avoid contact with potentially contaminated substances. Do not walk through puddles, pools, mud, or other such areas. Avoid, whenever possible, kneeling on the ground or leaning or sitting on drums, equipment, or the ground. Do not place monitoring equipment on potentially contaminated surfaces.
- Remove beards or facial hair that interfere with a satisfactory qualitative respirator fit test or routine pre-entry positive and negative pressure checks.
- Be familiar with and knowledgeable of and adhere to all instructions in the site-specific health and safety plan (HASP). At a minimum, a safety meeting will be held at the start of each project to discuss the HASP. Additional meetings will be held, as necessary, to address new or continuing safety and health concerns.
- Be aware of the location of the nearest telephone and all emergency telephone numbers.
- Attend a briefing on the anticipated hazards, equipment requirements, SWPs, emergency procedures, and communication methods before going on site.
- Plan and delineate entrance, exit, and emergency escape routes.
- Rehearse unfamiliar operations prior to implementation.
- Use the “buddy system” whenever respiratory protection equipment is in use. Buddies should establish hand signals or other means of emergency communication in case radios break down or are unavailable.
- Buddies should maintain visual contact with each other and with other on-site team members by remaining in close proximity in order to assist each other in case of emergency.

- Minimize the number of personnel and equipment in contaminated areas (such as the exclusion zone). Nonessential vehicles and equipment should remain within the support zone.

- Establish appropriate support, contamination reduction, and exclusion zones.

- Establish appropriate decontamination procedures for leaving the site.

- Immediately report all injuries, illnesses, and unsafe conditions, practices, and equipment to the site safety coordinator (SSC).

- Maintain a portion of the site field logbook as a project safety log. The project safety log will be used to record the names, entry and exit dates, and times on site of all Tetra Tech, subcontractor, and project site visitor personnel; air quality and personal exposure monitoring data; and other information related to safety matters. Form SSC-1, Daily Site Log, may be used to record names of on-site personnel.

- A portable eyewash station should be located in the support zone if chemical splashes to eyes are possible.

- Do not bring matches and lighters in the exclusion zone or contamination reduction zone.

- Observe coworkers for signs of toxic exposure and heat or cold stress.

- Inform coworkers of nonvisual effects of illness if you experience them, such as headaches, dizziness, nausea, or blurred vision.

TETRA TECH, INC.

HEALTH AND SAFETY MANUAL

VOLUME III

SAFE WORK PRACTICES (SWP)

RESPIRATOR QUALITATIVE FIT TESTING PROCEDURES

SWP NO.: 6-29

ISSUE DATE: APRIL 1999

REVISION NO.: 0

RESPIRATOR QUALITATIVE FIT TESTING PROCEDURES

The safe work practice (SWP) addresses the need for proper and thorough procedures for qualitative fit testing of respirators. The Occupational Safety and Health Administration (OSHA) regulates general industrial use of respiratory protection under Title 29 of the *Code of Federal Regulations* (CFR), Part 1910.134. Appendix A of the standard outlines mandatory procedures to use for both qualitative fit tests (QLFT) and quantitative fit tests (QNFT). This SWP was written to meet the requirements of Appendix A for QLFTs. This SWP must be used in conjunction with the Tetra Tech, Inc. (Tetra Tech), "Respiratory Protection Program," Document Control No. 2-6.

The following sections describe the SWP's applicability, qualifications of fit testers, and fit testing procedures for use during QLFTs.

1.0 APPLICABILITY

This SWP applies to all Tetra Tech employees who use respirators on the job and to employees who conduct any fit testing. In addition, when a Tetra Tech company or office uses an outside service to perform fit testing, the organization conducting the fit testing shall meet the minimum requirements for QLFT and QNFT procedures specified in Appendix A of the standard.

Respirator fit testing shall be conducted at the following intervals:

- Prior to initial use of a respirator
- Whenever a different respirator facepiece (size, style, model, or make) is used
- At least annually thereafter
- After any reported or observed changes in an employee's physical condition that could affect respirator fit. This includes but is not limited to, facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight.

If an employee notices that the fit of a respirator has become unacceptable, he or she will be given an opportunity to select another respirator facepiece.

2.0 QUALIFICATION OF FIT TESTERS

Tetra Tech employees who conduct QLFTs must demonstrate sufficient understanding and expertise in the required testing procedures. Fit testers shall qualify through appropriate education, experience, or both. Qualifications of fit testers shall be determined on a case-by-case basis by regional health and safety representatives (RHSR) or subsidiary health and safety representatives (SHSR) based on the fit tester's demonstrated knowledge of OSHA-mandated fit test procedures and performance of a simulated fit test. The RHSR or SHSR must ensure that persons administering fit tests are able to prepare test solutions, calibrate and operate equipment, perform tests properly, recognize invalid tests, and ensure that test equipment is in proper working order. The fit tester must also demonstrate how to clean and maintain equipment to operate within the parameters for which it was designed.

3.0 FIT TESTING PROCEDURES

Appendix A of 29 CFR 1910.134 provides instruction for five OSHA-accepted QLFT procedures. Tetra Tech has selected two of these procedures for its fit test program. The sections below describe general requirements that must be followed during all fit tests and for any fit test method used. Both the Bitrex™ and irritant smoke QLFT protocols are discussed below.

3.1 GENERAL REQUIREMENTS

QLFTs must be conducted in accordance with the general requirements discussed below.

- The test subject shall be shown how to put on a respirator, position it on the face, set strap tension, and determine an acceptable fit. A mirror shall be available to assist the subject in evaluating the fit and positioning the facepiece.

- The test subject must be allowed to choose from a sufficient selection of models and sizes to identify a respirator that fits correctly and is comfortable. The subject shall be informed that he or she is being asked to select the respirator that provides the most acceptable fit. The subject shall be asked to hold each chosen facepiece up to the face and eliminate those that obviously do not provide an acceptable fit.

- The subject shall don the most comfortable respirator and wear it for at least 5 minutes to assess comfort. If the subject is not familiar with a particular respirator, the subject shall be directed to don the mask several times and to adjust the straps each time to become adept at setting proper strap tension.

- The tester shall review the following points with the subject and allow the subject adequate time to determine the comfort of the respirator:

  - Position of the mask on the nose

  - Room for eye protection

  - Ability to talk

  - Position of the mask on the face and cheeks

- The following criteria shall be used to help determine the adequacy of the respirator fit:

  - Chin properly placed

  - Adequate strap tension (not overly tight)

  - Fit across nose bridge

  - Proper size to span distance from nose to chin

  - Tendency of respirator to slip

  - Self-observation in a mirror to evaluate fit and respirator position

- The subject shall conduct a user seal check using the negative- and positive-pressure seal check procedures described in Appendix A of this SWP. Before conducting the check, the subject shall be instructed to seat the mask on the face by moving the head from side to side and up and down slowly while taking a few slow, deep breaths. If the seal checks fail, the subject shall choose another facepiece.

- Seal checks and fit testing shall not be conducted if there is any facial hair growth such as stubble beard growth, beard, mustache, or sideburns that interferes with the facepiece sealing surface. Any interfering apparel shall be altered or removed.

- If the subject experiences difficulty in breathing during testing, the testing shall stop immediately and he or she shall be referred to a company physician for assessment.

- If the subject finds the fit of the respirator unacceptable, the subject shall be given the opportunity to select a different respirator and to be retested.

- Prior to commencement of the fit test, the subject shall be given a written description of the respirator user seal check procedures (see Appendix A) and exercises to perform during the testing. Exercises and a prepared text to be read during the test are included in Appendix B of this SWP.

- All exercises in Appendix B must be performed for all QLFT methods.

3.2 BITREX™ SOLUTION QUALITATIVE FIT TEST PROTOCOL

Bitrex™ solution (denatonium benzoate) is a taste aversion agent. To conduct a QLFT using Bitrex™, the test subject must first pass a taste threshold screening. The entire procedure must be explained to the test subject before the screening is conducted. The sections below describe taste threshold screening and fit test procedures. Particulate filters (cartridges) are used during this test.

3.2.1 Taste Threshold Screening

The taste threshold screening is intended to determine whether the individual tested can detect the taste of Bitrex™. The procedures below shall be used for the taste screening.

- Prior to testing, the tester shall prepare a quantity of threshold check solution by adding 13.5 milligrams (mg) of Bitrex™ to 100 milliliters (mL) of 5 percent salt solution in distilled water. A nebulizer for taste screening shall be clearly marked to distinguish it from the fit test solution nebulizer. The taste screening nebulizer shall be thoroughly rinsed in water, shaken to dry, and refilled at least each morning and afternoon or at least every 4 hours.

- During the taste screening as well as during the fit testing, subjects shall wear an enclosure around the head and shoulders that is approximately 12 inches in diameter by 14 inches tall. The front portion of the enclosure shall be clear from the respirator and allow free movement of the head when a respirator is worn. An enclosure substantially similar to the 3M hood assembly, parts #14 and #15 combined, is adequate.

- The test enclosure shall have a 0.75-inch hole in front of the test subject's nose and month area to accommodate the nebulizer nozzle.

- The test subject shall don the test enclosure. Throughout the threshold screening test, the test subject shall breathe through his or her slightly open mouth with tongue extended. The subject is instructed to report when he or she detects a bitter taste.

- Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, the test conductor shall spray the threshold check solution into the enclosure. To produce the aerosol, the nebulizer bulb is firmly squeezed so that the bulb collapses completely. The bulb is then released and allowed to fully expand. Correct use of the nebulizer means that approximately 1 mL of liquid is used at a time in the nebulizer body.

- The nebulizer should be rapidly squeezed 10 times and then the test subject is asked whether the Bitrex™ solution can be tasted. If the subject reports tasting the bitter taste during the 10 squeezes, the screening test is complete. The taste threshold is noted as 10 regardless of the number of squeezes actually completed.

- If the first response is negative, the nebulizer is rapidly squeezed 10 more times and the test subject is again asked whether the Bitrex™ solution is tasted. If the test subject reports tasting the bitter taste during the second 10 squeezes, the screening test is completed. The taste threshold is noted as 20 regardless of the number of squeezes actually completed.

- If the second response is negative, the nebulizer is rapidly squeezed 10 more times and the test subject is again asked whether the Bitrex™ solution is tasted. If the test subject reports tasting the bitter taste during the third 10 squeezes, the screening test is completed. The taste threshold is noted as 30 regardless of the number of squeezes actually completed.

- If the Bitrex™ solution is not tasted after 30 squeezes, the test subject is unable to taste the Bitrex™ solution and cannot be fit tested using the Bitrex™ solution test.

- The tester will note the number of squeezes required to solicit a taste response. When a taste response has been elicited, the test subject shall be asked to note the taste for reference in the fit test.

3.2.2 Bitrex™ Solution Fit Test Procedures

The procedures below must be followed to conduct the actual Bitrex™ solution fit test:

- A fit test solution is prepared by adding 337.5 mg of Bitrex™ to 200 mL of a 5 percent salt solution in warm water. A second nebulizer dedicated to fit testing shall be clearly marked to distinguish it from the taste screening solution nebulizer. The nebulizer shall be thoroughly rinsed in water, shaken to dry, and refilled at least each morning and afternoon or at least every 4 hours.

- The test subject shall be instructed not to each, drink, smoke, or chew gum for 15 minutes before the test.

- The person being fit tested shall don the respirator without assistance and perform the required user seal check (see Appendix A).

- The fit test uses the same enclosure described for taste threshold screening in Section 3.2.1. The test subject shall don the enclosure while wearing the respirator selected as described in the general requirements in Section 3.1. The respirator shall be properly adjusted and equipped with particulate filter(s).

- As before, the test subject shall breathe through his or her slightly opened mouth with tongue extended, and shall be instructed to report is he or she tastes the bitter taste of Bitrex™

- The nebulizer is inserted into the hole in front of the enclosure, and an initial concentration of the fit test solution is sprayed into the enclosure using the same number of squeezes (either 10, 20, or 30) based on the number of squeezes required to elicit taste response noted during the screening test.

- After generating the aerosol, the test subject shall be instructed to perform the test exercises provided in Appendix B.

- Every 30 seconds, the aerosol concentration shall be replenished using one half the number of squeezes used initially (such as 5, 10, or 15).

- The test subject shall indicate to the tester if at any time during the fit test the taste of Bitrex™ solution is detected. If the test subject does not report tasting the Bitrex™ solution, the test is passed.

- If the taste of Bitrex™ solution is detected, the fit is deemed unsatisfactory and the test is failed. A different respirator shall be tried, and the entire test procedure (screening and test) is repeated.

3.3 IRRITANT SMOKE (STANNIC CHLORIDE) QUALITATIVE FIT TEST PROTOCOL

This QLFT uses a person's response to irritating chemicals released in the "smoke" produced by a stannic chloride ventilation smoke tube to detect leakage into the respirator. To conduct this QLFT, the general requirements and precautions, a sensitivity screening check, and fit test procedures discussed below must be followed.

3.3.1 General Requirements and Precautions

General requirements and precautions related to the irritant smoke QLFT are discussed below.

- The respirator to be tested shall be equipped with high-efficiency particulate air (HEPA) or P100 series filter(s). Tetra Tech recommends that the person performing the fit test also wear a full-face respirator with HEPA or P100 series filters.

- Only stannic chloride smoke tubes shall be used for this protocol.

- No test enclosure or hood for the test subject shall be used.

- The smoke can irritate the eyes, lungs, and nasal passages. The test conductor shall take precautions to minimize the test subject's exposure to irritant smoke. Sensitivity varies, and certain individuals may respond to a greater degree to irritant smoke. Care shall be taken when performing the sensitivity screening checks that only the minimum amount of smoke is used necessary to elicit a response from the test subject.

- The fit test shall be performed in an area with adequate ventilation to prevent exposure of the person conducting the fit test or buildup of irritant smoke in the general atmosphere.

3.3.2 Sensitivity Screening Check

The person to be tested must demonstrate his or her ability to detect a weak concentration of the irritant smoke as discussed below.

- The tester shall break both ends of a ventilation smoke tube containing stannic chloride and attach one end of the smoke tube to (1) a low-flow air pump set to deliver 200 mL per minute or (2) an aspirator squeeze bulb. The test operator shall cover the other end of the smoke tube with a short piece of tubing to prevent potential injury from the jagged end of the smoke tube.

- The test operator shall advise the test subject that the smoke can be irritating to the eyes, lungs, and nasal passages and instruct the subject to keep his or her eyes closed while the test is performed.

- The test subject shall be allowed to smell a weak concentration of the irritant smoke before the respirator is donned to become familiar with its irritating properties and to determine if he or she can detect the irritating properties of the smoke. The test operator shall carefully direct a small amount of the irritant smoke in the test subject's direction to determine if he or she can detect it.

3.3.3 Irritant Smoke Fit Test Procedures

The procedures below must be followed to conduct the actual irritant smoke fit test.

- The person being fit tested shall don the respirator without assistance and perform the required user seal check (see Appendix A).

- The test subject shall be instructed to keep his or her eyes closed.

- The tester shall direct the stream of irritant smoke from the smoke tube toward the face seal area of the test subject using the low-flow pump or squeeze bulb at least 12 inches from the facepiece. The tester shall move the smoke stream around the whole perimeter of the mask. The tester shall gradually make two more passes around the perimeter of the mask, moving to within 6 inches of the respirator.

- If the person being tested does not have an involuntary response or detect the irritant smoke, the test should proceed with the test exercises provided in Appendix B.

- The test exercises shall be performed by the test subject while the respirator seal is being continually challenged by the smoke around the perimeter of the respirator at a distance of 6 inches.

- If the person being fit tested reports detecting the irritant smoke at any time, the fit test is failed. The person being retested must repeat the entire sensitivity check and fit test procedure.

- Each test subject passing the irritant smoke test without evidence of a response is required to undergo a second sensitivity screening check after the respirator has been removed using the smoke from the same smoke tube used during the fit test to determine whether he or she still reacts to the smoke. Failure to evoke a response shall render the fit test void. If the subject responds during the second sensitivity check, the fit test is passed.

APPENDIX A

RESPIRATOR USER SEAL CHECK PROCEDURES

APPENDIX A

RESPIRATOR USER SEAL CHECK PROCEDURE

Individuals using tight-fitting respirators must perform a user seal check each time a respirator is put on to ensure that an adequate seal is achieved. Two methods are available for use; one is the positive- and negative-pressure check and the other is the respirator manufacturer's method. Either the positive- and negative-pressure checks described below may be used or, if a manufacturer of a particular respirator brand has developed its own recommended seal check method, that method may be used in place of the negative- and positive-pressure seal checks. User seal checks are not a substitute for qualitative or quantitative fit tests. The user check procedures described below are as described in the mandatory Appendix B-1 of Title 29 of the *Code of Federal Regulations*, Part 1910.134.

- Positive-Pressure Check

  Close off the exhalation valve and exhale gently into the facepiece. The face fit is considered satisfactory if a slight positive pressure can be built up inside the facepiece without any evidence of outward leakage of air at the seal. For most respirators, this method of leak testing requires the wearer to first remove the exhalation valve cover before closing off the exhalation valve and then carefully replace it after the test.

- Negative-Pressure Check

  Close off the inlet opening(s) of the canister or cartridge(s) by covering the opening with the palm of the hand(s) or by replacing the filter seal(s). Inhale gently so that the facepiece collapses slightly, and hold the breath for 10 seconds. The inlet opening of some cartridges cannot be effectively covered with the palm of the hand. In this case, the test can be performed by covering the inlet opening of the cartridge with a thin latex or nitrile glove. If the facepiece remains in its slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is considered satisfactory.

APPENDIX B

RESPIRATOR FIT TEST EXERCISES

RESPIRATOR FIT TEST EXERCISES

Test subjects shall perform the exercises below during fit test process. Prior to the actual fit test, the test subject shall (1) select a suitable and comfortable respirator; (2) don, adjust, and then wear the respirator for 5 minutes to assess comfort; (3) conduct a user seal check in accordance with the procedures outlined in Appendix A, (4) report any difficulties breathing while wearing the respirator, (5) select a different respirator if the fit and level of comfort is unacceptable, and (6) perform the fit test exercises described below in the order listed. The qualitative fit test (QLFT) shall be performed in a test environment.

Test Exercises

Each exercises below shall be conducted for 1 minute. During testing, the subject will be questioned and observed to determine if the respirator is comfortable. The respirator shall not be adjusted during the fit testing procedure. Any adjustment voids the test, and the test must be repeated from the beginning.

1. **Normal breathing.** In a normal standing position without talking, breathe normally.
2. **Deep breathing.** In a normal standing position, breathe slowly and deeply. Be careful not to hyperventilate.
3. **Turning head from side to side.** Standing in place, slowly turn the head from side to side between the extreme positions on each side. Hold the head at each extreme momentarily and inhale at each side.
4. **Moving head up and down**. Standing in place, slowly move the head up and down. Inhale in the up position (such as when looking toward the ceiling).
5. **Talking.** Talk out loud slowly and loud enough to be heard clearly by the fit tester. Read the entire “Rainbow Passage” on the next page.
6. **Bending over.** Bend at the waist as if to touch the toes.
7. **Normal breathing.** Complete the same exercise as item 1 above.

After these test exercises are completed, the tester shall ask the test subject about the comfort of the respirator. If the respirator is uncomfortable, another respirator shall be tried and the fit test, as well as user check and screening procedures, will be repeated.

RAINBOW PASSAGE

“When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.”

Source: Appendix A of Title 29 of the *Code of Federal Regulations*, Part 1910.134

SITE SPECIFIC HEALTH AND SAFETY PLAN

APPENDIX C

RESPIRATORY HAZARD ASSESSMENT (FORM RP-2)

(Two Sheets)

Note: This assessment form will be finalized if gasses or vapors are encountered and is not required for asbestos sampling.

TETRA TECH, INC.

RESPIRATORY HAZARD ASSESSMENT

Project Name:		Project No.:
Location:		Project Manager:
Type: ☐ Baseline ☐ Reassessment	Date:	Valid for _____ days
Job/Task Description:		☐ Routine ☐ Escape

Hazard Identification and Source:	Workplace Factors: Temperature: ___________ Humidity: ___________ Other: ___________	User Factors: Work rate: ___________ Protective clothing: ___________ Other: ___________

Chemical:					
PEL:					
ACGIH TLV:					
Form (part/gas/vapor):					
IDLH:					
Eye Irritant (Y/N):					
Skin Absorption(Y/N):					
Monitoring (Y/N) :*					
Frequency:					
Maximum Concentration Estimated:**					

* Monitoring Method:

☐ PID ☐ NIOSH method: ___________

☐ FID ☐ Vapor badge: ___________

☐ Detector tube: ___________ ☐ Other: ___________

Respirator Type:

☐ Half-face disposable Brand: ___________

☐ Half-face reusable Brand: ___________

☐ Full-face Brand: ___________

☐ Air-supplied airline Brand: ___________

☐ Air-supplied SCBA Brand: ___________

☐ PAPR Brand: ___________

☐ ESCBA Brand: ___________

** If concentrations exceed the immediately dangerous to life and health (IDLH) value, use air-supplied systems.

Vapor and Gas Cartridge Exchange:

ESLI: ☐ Yes ☐ No

Exchange frequency: ___________

Cartridge/Filter Selection

☐ N100 ☐ R100 ☐ P100

☐ N99 ☐ R99 ☐ P99

☐ N95 ☐ R95 ☐ P95

☐ Organic vapor ☐ Acid gas

☐ Ammonia ☐ Mercury ☐ Formaldehyde

☐ Combo: ___________

☐ Other: ___________

Basis for Exchange Frequency

☐ Manufacturer's data ☐ Workplace simulations

☐ Experimental methods ☐ AIHA "Rules of Thumb"

☐ Predictive modeling ☐ Analogous chemical structure

☐ OSHA Regulation: ___________

☐ Other: ___________

Completed by	Date	Reviewed by	Date

DEFINITIONS AND ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
ESLI	End of service life indicator
FID	Flame ionization detector
IDLH	Immediately dangerous to life and health
NIOSH	National Institute for Occupational Safety and Health
N100/99/95	Non-oil-proof particulate filter
OSHA	Occupational Safety and Health Administration
P100/99/95	Oil-proof particulate filter
PEL	Permissible exposure limit
PID	Photoionization detector
PPE	Personal protective equipment
R100/99/95	Oil-resistant particulate filter
SCBA	Self-contained breathing apparatus
TLV	Threshold limit value

Note: This form must be reviewed by a regional health and safety representative or subsidiary health and safety representative (or designee) only and must be attached to the site-specific health and safety plan once completed. A copy must also be placed in the project files.

SITE SPECIFIC HEALTH AND SAFETY PLAN

APPENDIX D

NIOSH ANALYTICAL METHOD 7400

ASBESTOS and OTHER FIBERS by PCM 7400

Various MW: Various CAS: Various RTECS: Various

METHOD: 7400, Issue 2	EVALUATION: FULL	Issue 1: Rev. 3 on 15 May 1989 Issue 2: 15 August 1994

OSHA : 0.1 asbestos fiber (> 5 µm long)/cc; 1 f/cc/30 min excursion; carcinogen
MSHA: 2 asbestos fibers/cc
NIOSH: 0.1 f/cc (fibers > 5 µm long)/400 L; carcinogen
ACGIH: 0.2 crocidolite; 0.5 amosite; 2 chrysotile and other asbestos, fibers/cc; carcinogen

PROPERTIES: solid, fibrous, crystalline, anisotropic

SYNONYMS [CAS #]: actinolite **[77536-66-4]** or ferroactinolite **[15669-07-5]**; amosite **[12172-73-5]**; anthophyllite **[77536-67-5]**; chrysotile **[12001-29-5]**; serpentine **[18786-24-8]**; crocidolite **[12001-28-4]**; tremolite **[77536-68-6]**; amphibole asbestos **[1332-21-4]**; refractory ceramic fibers **[142844-00-6]**; fibrous glass.

SAMPLING

SAMPLER:	FILTER (0.45- to 1.2-µm cellulose ester membrane, 25-mm; conductive cowl on cassette)
FLOW RATE*:	0.5 to 16 L/min
VOL-MIN*:	400 L @ 0.1 fiber/cc
-MAX*:	(step 4, sampling) *Adjust to give 100 to 1300 fiber/mm^2
SHIPMENT:	routine (pack to reduce shock)
SAMPLE STABILITY:	stable
BLANKS:	2 to 10 field blanks per set

ACCURACY

RANGE STUDIED:	80 to 100 fibers counted
BIAS:	See EVALUATION OF METHOD
OVERALL PRECISION ($\hat{S}_{rT}$):	0.115 to 0.13 [1]
ACCURACY:	See EVALUATION OF METHOD

MEASUREMENT

TECHNIQUE:	LIGHT MICROSCOPY, PHASE CONTRAST
ANALYTE:	fibers (manual count)
SAMPLE PREPARATION:	acetone - collapse/triacetin - immersion
COUNTING RULES:	described in previous version of this method as "A" rules [1,3]
EQUIPMENT:	1. positive phase-contrast microscope 2. Walton-Beckett graticule (100-µm field of view) Type G-22 3. phase-shift test slide (HSE/NPL)
CALIBRATION:	HSE/NPL test slide
RANGE:	100 to 1300 fibers/mm^2 filter area
ESTIMATED LOD:	7 fibers/mm^2 filter area
PRECISION ($\bar{S}_r$):	0.10 to 0.12 [1]; see EVALUATION OF METHOD

APPLICABILITY: The quantitative working range is 0.04 to 0.5 fiber/cc for a 1000-L air sample. The LOD depends on sample volume and quantity of interfering dust, and is <0.01 fiber/cc for atmospheres free of interferences. The method gives an index of airborne fibers. It is primarily used for estimating asbestos concentrations, though PCM does not differentiate between asbestos and other fibers. Use this method in conjunction with electron microscopy (e.g., Method 7402) for assistance in identification of fibers. Fibers < ca. 0.25 µm diameter will not be detected by this method [4]. This method may be used for other materials such as fibrous glass by using alternate counting rules (see Appendix C).

INTERFERENCES: If the method is used to detect a specific type of fiber, any other airborne fiber may interfere since all particles meeting the counting criteria are counted. Chain-like particles may appear fibrous. High levels of non-fibrous dust particles may obscure fibers in the field of view and increase the detection limit.

OTHER METHODS: This revision replaces Method 7400, Revision #3 (date 5/15/89).

REAGENTS:

1. Acetone,* reagent grade.
2. Triacetin (glycerol triacetate), reagent grade.

* See SPECIAL PRECAUTIONS.

EQUIPMENT:

1. Sampler: field monitor, 25-mm, three-piece cassette with ca. 50-mm electrically conductive extension cowl and cellulose ester filter, 0.45- to 1.2-µm pore size, and backup pad.
   - NOTE 1: Analyze representative filters for fiber background before use to check for clarity and background. Discard the filter lot if mean is ≥5 fibers per 100 graticule fields. These are defined as laboratory blanks. Manufacturer-provided quality assurance checks on filter blanks are normally adequate as long as field blanks are analyzed as described below.
   - NOTE 2: The electrically conductive extension cowl reduces electrostatic effects. Ground the cowl when possible during sampling.
   - NOTE 3: Use 0.8-µm pore size filters for personal sampling. The 0.45-µm filters are recommended for sampling when performing TEM analysis on the same samples. However, their higher pressure drop precludes their use with personal sampling pumps.
   - NOTE 4: Other cassettes have been proposed that exhibit improved uniformity of fiber deposit on the filter surface, e.g., bellmouthed sampler (Envirometrics, Charleston, SC). These may be used if shown to give measured concentrations equivalent to sampler indicated above for the application.
2. Personal sampling pump, battery or line-powered vacuum, of sufficient capacity to meet flow-rate requirements (see step 4 for flow rate), with flexible connecting tubing.
3. Wire, multi-stranded, 22-gauge; 1", hose clamp to attach wire to cassette.
4. Tape, shrink- or adhesive-.
5. Slides, glass, frosted-end, pre-cleaned, 25 x 75-mm.
6. Cover slips, 22- x 22-mm, No. 1-1/2, unless otherwise specified by microscope manufacturer.
7. Lacquer or nail polish.
8. Knife, #10 surgical steel, curved blade.
9. Tweezers.

EQUIPMENT:

10. Acetone flash vaporization system for clearing filters on glass slides (see ref. [5] for specifications or see manufacturer's instructions for equivalent devices).
11. Micropipets or syringes, 5-µL and 100- to 500-µL.
12. Microscope, positive phase (dark) contrast, with green or blue filter, adjustable field iris, 8 to 10X eyepiece, and 40 to 45X phase objective (total magnification ca. 400X); numerical aperture = 0.65 to 0.75.
13. Graticule, Walton-Beckett type with 100-µm diameter circular field (area = 0.00785 mm2) at the specimen plane (Type G-22). Available from Optometrics USA, P.O. Box 699, Ayer, MA 01432 [phone (508)-772-1700], and McCrone Accessories and Components, 850 Pasquinelli Drive, Westmont, IL 60559 [phone (312) 887-7100].
    NOTE: The graticule is custom-made for each microscope. (see APPENDIX A for the custom-ordering procedure).
14. HSE/NPL phase contrast test slide, Mark II. Available from Optometrics USA (address above).
15. Telescope, ocular phase-ring centering.
16. Stage micrometer (0.01-mm divisions).

SPECIAL PRECAUTIONS: Acetone is extremely flammable. Take precautions not to ignite it. Heating of acetone in volumes greater than 1 mL must be done in a ventilated laboratory fume hood using a flameless, spark- free heat source.

SAMPLING:

1. Calibrate each personal sampling pump with a representative sampler in line.
2. To reduce contamination and to hold the cassette tightly together, seal the crease between the cassette base and the cowl with a shrink band or light colored adhesive tape. For personal sampling, fasten the (uncapped) open-face cassette to the worker's lapel. The open face should be oriented downward.
   NOTE: The cowl should be electrically grounded during area sampling, especially under conditions of low relative humidity. Use a hose clamp to secure one end of the wire (Equipment, Item 3) to the monitor's cowl. Connect the other end to an earth ground (i.e., cold water pipe).
3. Submit at least two field blanks (or 10% of the total samples, whichever is greater) for each set of samples. Handle field blanks in a manner representative of actual handling of associated samples in the set. Open field blank cassettes at the same time as other cassettes just prior to sampling. Store top covers and cassettes in a clean area (e.g., a closed bag or box) with the top covers from the sampling cassettes during the sampling period.
4. Sample at 0.5 L/min or greater [6]. Adjust sampling flow rate, Q (L/min), and time, t (min), to produce a fiber density, E, of 100 to 1300 fibers/mm^2 ($3.85 \cdot 10^4$ to $5 \cdot 10^5$ fibers per 25-mm filter with effective collection area A_c= 385 mm^2) for optimum accuracy. These variables are related to the action level (one-half the current standard), L (fibers/cc), of the fibrous aerosol being sampled by:

$$t = \frac{A_c \cdot E}{Q \cdot L \cdot 10^3}, \text{ min.}$$

NOTE 1: The purpose of adjusting sampling times is to obtain optimum fiber loading on the filter. The collection efficiency does not appear to be a function of flow rate in the range of 0.5 to 16 L/min for asbestos fibers [7]. Relatively large diameter fibers (>3 µm) may exhibit significant aspiration loss and inlet deposition. A sampling rate of 1 to 4 L/min for 8 h is appropriate in atmospheres containing ca. 0.1 fiber/cc in the absence of significant amounts of non-asbestos dust. Dusty atmospheres require smaller sample volumes (≤400 L) to obtain countable samples. In such cases take short, consecutive samples and average the results over the total collection time. For documenting episodic exposures, use high flow rates (7 to 16 L/min) over shorter sampling times. In relatively clean atmospheres, where targeted fiber concentrations are much less than 0.1 fiber/cc, use larger sample volumes (3000 to 10000 L) to achieve quantifiable loadings. Take care, however, not to overload the filter with background dust. If ≥ 50% of the filter surface is covered with particles, the filter may be too overloaded to count and will bias the measured fiber concentration.

NOTE 2: OSHA regulations specify a minimum sampling volume of 48 L for an excursion measurement, and a maximum sampling rate of 2.5 L/min [3].

5. At the end of sampling, replace top cover and end plugs.
6. Ship samples with conductive cowl attached in a rigid container with packing material to prevent jostling or damage.

   NOTE: Do not use untreated polystyrene foam in shipping container because electrostatic forces may cause fiber loss from sample filter.

SAMPLE PREPARATION:

NOTE 1: The object is to produce samples with a smooth (non-grainy) background in a medium with refractive index ≤1.46. This method collapses the filter for easier focusing and produces permanent (1 - 10 years) mounts which are useful for quality control and interlaboratory comparison. The aluminum "hot block" or similar flash vaporization techniques may be used outside the laboratory [2]. Other mounting techniques meeting the above criteria may also be used (e.g., the laboratory fume hood procedure for generating acetone vapor as described in Method 7400 - revision of 5/15/85, or the non-permanent field mounting technique used in P&CAM 239 [3,7,8,9]). Unless the effective filtration area is known, determine the area and record the information referenced against the sample ID number [1,9,10,11].

NOTE 2: Excessive water in the acetone may slow the clearing of the filter, causing material to be washed off the surface of the filter. Also, filters that have been exposed to high humidities prior to clearing may have a grainy background.

7. Ensure that the glass slides and cover slips are free of dust and fibers.
8. Adjust the rheostat to heat the "hot block" to ca. 70 °C [2].

   NOTE: If the "hot block" is not used in a fume hood, it must rest on a ceramic plate and be isolated from any surface susceptible to heat damage.
9. Mount a wedge cut from the sample filter on a clean glass slide.
   a. Cut wedges of ca. 25% of the filter area with a curved-blade surgical steel knife using a rocking motion to prevent tearing. Place wedge, dust side up, on slide.

      NOTE: Static electricity will usually keep the wedge on the slide.

b. Insert slide with wedge into the receiving slot at base of "hot block". Immediately place tip of a micropipet containing ca. 250 µL acetone (use the minimum volume needed to consistently clear the filter sections) into the inlet port of the PTFE cap on top of the "hot block" and inject the acetone into the vaporization chamber with a slow, steady pressure on the plunger button while holding pipet firmly in place. After waiting 3 to 5 sec for the filter to clear, remove pipet and slide from their ports.

CAUTION: Although the volume of acetone used is small, use safety precautions. Work in a well-ventilated area (e.g., laboratory fume hood). Take care not to ignite the acetone. Continuous use of this device in an unventilated space may produce explosive acetone vapor concentrations.

c. Using the 5-µL micropipet, immediately place 3.0 to 3.5 µL triacetin on the wedge. Gently lower a clean cover slip onto the wedge at a slight angle to reduce bubble formation. Avoid excess pressure and movement of the cover glass.

NOTE: If too many bubbles form or the amount of triacetin is insufficient, the cover slip may become detached within a few hours. If excessive triacetin remains at the edge of the filter under the cover slip, fiber migration may occur.

d. Mark the outline of the filter segment with a glass marking pen to aid in microscopic evaluation.

e. Glue the edges of the cover slip to the slide using lacquer or nail polish [12]. Counting may proceed immediately after clearing and mounting are completed.

NOTE: If clearing is slow, warm the slide on a hotplate (surface temperature 50 °C) for up to 15 min to hasten clearing. Heat carefully to prevent gas bubble formation.

CALIBRATION AND QUALITY CONTROL:

10. Microscope adjustments. Follow the manufacturers instructions. At least once daily use the telescope ocular (or Bertrand lens, for some microscopes) supplied by the manufacturer to ensure that the phase rings (annular diaphragm and phase-shifting elements) are concentric. With each microscope, keep a logbook in which to record the dates of microscope cleanings and major servicing.
    a. Each time a sample is examined, do the following:
        (1) Adjust the light source for even illumination across the field of view at the condenser iris. Use Kohler illumination, if available. With some microscopes, the illumination may have to be set up with bright field optics rather than phase contract optics.
        (2) Focus on the particulate material to be examined.
        (3) Make sure that the field iris is in focus, centered on the sample, and open only enough to fully illuminate the field of view.
    b. Check the phase-shift detection limit of the microscope periodically for each analyst/microscope combination:
        (1) Center the HSE/NPL phase-contrast test slide under the phase objective.
        (2) Bring the blocks of grooved lines into focus in the graticule area.

        NOTE: The slide contains seven blocks of grooves (ca. 20 grooves per block) in descending order of visibility. For asbestos counting the microscope optics must completely resolve the grooved lines in block 3 although they may appear somewhat faint, and the grooved lines in blocks 6 and 7 must be invisible when centered in the graticule area. Blocks 4 and 5 must be at least partially visible but may vary slightly in visibility between microscopes. A microscope which fails to meet these requirements has resolution either too low or too high for fiber counting.

        (3) If image quality deteriorates, clean the microscope optics. If the problem persists, consult the microscope manufacturer.
11. Document the laboratory's precision for each counter for replicate fiber counts.
    a. Maintain as part of the laboratory quality assurance program a set of reference slides to be used on a daily basis [13]. These slides should consist of filter preparations including a range of loadings and background dust levels from a variety of sources including both field and reference samples (e.g., PAT, AAR, commercial samples). The Quality Assurance Officer

should maintain custody of the reference slides and should supply each counter with a minimum of one reference slide per workday. Change the labels on the reference slides periodically so that the counter does not become familiar with the samples.

b. From blind repeat counts on reference slides, estimate the laboratory intra- and intercounter precision. Obtain separate values of relative standard deviation (S_r) for each sample matrix analyzed in each of the following ranges: 5 to 20 fibers in 100 graticule fields, >20 to 50 fibers in 100 graticule fields, and >50 to 100 fibers in 100 graticule fields. Maintain control charts for each of these data files.

   NOTE: Certain sample matrices (e.g., asbestos cement) have been shown to give poor precision [9]

12. Prepare and count field blanks along with the field samples. Report counts on each field blank.

    NOTE 1: The identity of blank filters should be unknown to the counter until all counts have been completed.

    NOTE 2: If a field blank yields greater than 7 fibers per 100 graticule fields, report possible contamination of the samples.

13. Perform blind recounts by the same counter on 10% of filters counted (slides relabeled by a person other than the counter). Use the following test to determine whether a pair of counts by the same counter on the same filter should be rejected because of possible bias: Discard the sample if the absolute value of the difference between the square roots of the two counts (in fiber/mm^2) exceeds 2.77 (X)S_r', where X = average of the square roots of the two fiber counts

    (in fiber/mm^2) and $S_r' = \frac{S_r}{2}$, where S_r is the intracounter relative standard deviation for the

    appropriate count range (in fibers) determined in step 11. For more complete discussions see reference [13].

    NOTE 1: Since fiber counting is the measurement of randomly placed fibers which may be described by a Poisson distribution, a square root transformation of the fiber count data will result in approximately normally distributed data [13].

    NOTE 2: If a pair of counts is rejected by this test, recount the remaining samples in the set and test the new counts against the first counts. Discard all rejected paired counts. It is not necessary to use this statistic on blank counts.

14. The analyst is a critical part of this analytical procedure. Care must be taken to provide a non-stressful and comfortable environment for fiber counting. An ergonomically designed chair should be used, with the microscope eyepiece situated at a comfortable height for viewing. External lighting should be set at a level similar to the illumination level in the microscope to reduce eye fatigue. In addition, counters should take 10-to-20 minute breaks from the microscope every one or two hours to limit fatigue [14]. During these breaks, both eye and upper back/neck exercises should be performed to relieve strain.

15. All laboratories engaged in asbestos counting should participate in a proficiency testing program such as the AIHA-NIOSH Proficiency Analytical Testing (PAT) Program for asbestos and routinely exchange field samples with other laboratories to compare performance of counters.

MEASUREMENT:

16. Center the slide on the stage of the calibrated microscope under the objective lens. Focus the microscope on the plane of the filter.

17. Adjust the microscope (Step 10).

    NOTE: Calibration with the HSE/NPL test slide determines the minimum detectable fiber diameter (ca. 0.25 µm) [4].

18. Counting rules: (same as P&CAM 239 rules [1,10,11]: see examples in APPENDIX B).

    a. Count any fiber longer than 5 µm which lies entirely within the graticule area.

       (1) Count only fibers longer than 5 µm. Measure length of curved fibers along the curve.

       (2) Count only fibers with a length-to-width ratio equal to or greater than 3:1.

    b. For fibers which cross the boundary of the graticule field:

       (1) Count as 1/2 fiber any fiber with only one end lying within the graticule area, provided that the fiber meets the criteria of rule a above.

(2) Do not count any fiber which crosses the graticule boundary more than once.
(3) Reject and do not count all other fibers.

c. Count bundles of fibers as one fiber unless individual fibers can be identified by observing both ends of a fiber.

d. Count enough graticule fields to yield 100 fibers. Count a minimum of 20 fields. Stop at 100 graticule fields regardless of count.

19. Start counting from the tip of the filter wedge and progress along a radial line to the outer edge. Shift up or down on the filter, and continue in the reverse direction. Select graticule fields randomly by looking away from the eyepiece briefly while advancing the mechanical stage. Ensure that, as a minimum, each analysis covers one radial line from the filter center to the outer edge of the filter. When an agglomerate or bubble covers ca. 1/6 or more of the graticule field, reject the graticule field and select another. Do not report rejected graticule fields in the total number counted.

NOTE 1: When counting a graticule field, continuously scan a range of focal planes by moving the fine focus knob to detect very fine fibers which have become embedded in the filter. The small-diameter fibers will be very faint but are an important contribution to the total count. A minimum counting time of 15 seconds per field is appropriate for accurate counting.

NOTE 2: This method does not allow for differentiation of fibers based on morphology. Although some experienced counters are capable of selectively counting only fibers which appear to be asbestiform, there is presently no accepted method for ensuring uniformity of judgment between laboratories. It is, therefore, incumbent upon all laboratories using this method to report <u>total</u> fiber counts. If serious contamination from non-asbestos fibers occurs in samples, other techniques such as transmission electron microscopy must be used to identify the asbestos fiber fraction present in the sample (see NIOSH Method 7402). In some cases (i.e., for fibers with diameters >1 µm), polarized light microscopy (as in NIOSH Method 7403) may be used to identify and eliminate interfering non-crystalline fibers [15].

NOTE 3: Do not count at edges where filter was cut. Move in at least 1 mm from the edge.

NOTE 4: Under certain conditions, electrostatic charge may affect the sampling of fibers. These electrostatic effects are most likely to occur when the relative humidity is low (below 20%), and when sampling is performed near the source of aerosol. The result is that deposition of fibers on the filter is reduced, especially near the edge of the filter. If such a pattern is noted during fiber counting, choose fields as close to the center of the filter as possible [5].

NOTE 5: Counts are to be recorded on a data sheet that provides, as a minimum, spaces on which to record the counts for each field, filter identification number, analyst's name, date, total fibers counted, total fields counted, average count, fiber density, and commentary. Average count is calculated by dividing the total fiber count by the number of fields observed. Fiber density (fibers/mm^2) is defined as the average count (fibers/field) divided by the field (graticule) area (mm^2/field).

CALCULATIONS AND REPORTING OF RESULTS

20. Calculate and report fiber density on the filter, E (fibers/mm^2), by dividing the average fiber count per graticule field, F/n_f, minus the mean field blank count per graticule field, B/n_b, by the graticule field area, A_f (approx. 0.00785 mm^2):

$$\mathbf{E} = \frac{\left(\frac{F}{n_f} - \frac{B}{n_b}\right)}{A_f}, \ \mathbf{fibers/mm^2}.$$

NOTE: Fiber counts above 1300 fibers/mm^2 and fiber counts from samples with >50% of filter area covered with particulate should be reported as "uncountable" or "probably biased." Other fiber counts outside the 100-1300 fiber/mm^2 range should be reported as having "greater than optimal variability" and as being "probably biased."

21. Calculate and report the concentration, C (fibers/cc), of fibers in the air volume sampled, V (L), using the effective collection area of the filter, A_c (approx. 385 mm^2 for a 25-mm filter):

$$C = \frac{(E)(A_c)}{V \cdot 10^3}.$$

NOTE: Periodically check and adjust the value of A_c, if necessary.

22. Report intralaboratory and interlaboratory relative standard deviations (from Step 11) with each set of results.

NOTE: Precision depends on the total number of fibers counted [1,16]. Relative standard deviation is documented in references [1,15-17] for fiber counts up to 100 fibers in 100 graticule fields. Comparability of interlaboratory results is discussed below. As a first approximation, use 213% above and 49% below the count as the upper and lower confidence limits for fiber counts greater than 20 (Fig. 1).

EVALUATION OF METHOD:

A. This method is a revision of P&CAM 239 [10]. A summary of the revisions is as follows:

1. Sampling:
   The change from a 37-mm to a 25-mm filter improves sensitivity for similar air volumes. The change in flow rates allows for 2-m^3 full-shift samples to be taken, providing that the filter is not overloaded with non-fibrous particulates. The collection efficiency of the sampler is not a function of flow rate in the range 0.5 to 16 L/min [10].
2. Sample Preparation Technique:
   The acetone vapor-triacetin preparation technique is a faster, more permanent mounting technique than the dimethyl phthalate/diethyl oxalate method of P&CAM 239 [2,4,10]. The aluminum "hot block" technique minimizes the amount of acetone needed to prepare each sample.
3. Measurement:
   a. The Walton-Beckett graticule standardizes the area observed [14,18,19].
   b. The HSE/NPL test slide standardizes microscope optics for sensitivity to fiber diameter [4,14].
   c. Because of past inaccuracies associated with low fiber counts, the minimum recommended loading has been increased to 100 fibers/mm^2 filter area (a total of 78.5 fibers counted in 100 fields, each with field area = .00785 mm^2.) Lower levels generally result in an overestimate of the fiber count when compared to results in the recommended analytical range [20]. The recommended loadings should yield intracounter S_r in the range of 0.10 to 0.17 [21,22,23].

B. Interlaboratory comparability:
An international collaborative study involved 16 laboratories using prepared slides from the asbestos cement, milling, mining, textile, and friction material industries [9]. The relative standard deviations (S_r) varied with sample type and laboratory. The ranges were:

	Intralaboratory S_r	Interlaboratory S_r	Overall S_r
AIA (NIOSH A Rules)*	0.12 to 0.40	0.27 to 0.85	0.46
Modified CRS (NIOSH B Rules)**	0.11 to 0.29	0.20 to 0.35	0.25

* Under AIA rules, only fibers having a diameter less than 3 µm are counted and fibers attached to particles larger than 3 µm are not counted. NIOSH A Rules are otherwise similar to the AIA rules.

** See Appendix C.

A NIOSH study conducted using field samples of asbestos gave intralaboratory S_r in the range 0.17 to 0.25 and an interlaboratory S_r of 0.45 [21]. This agrees well with other recent studies [9,14,16].

At this time, there is no independent means for assessing the overall accuracy of this method. One measure of reliability is to estimate how well the count for a single sample agrees with the mean count from a large number of laboratories. The following discussion indicates how this estimation can be carried out based on measurements of the interlaboratory variability, as well as showing how the results of this method relate to the theoretically attainable counting precision and to measured intra- and interlaboratory S_r. (NOTE: The following discussion does not include bias estimates and should not be taken to indicated that lightly loaded samples are as accurate as properly loaded ones).

Theoretically, the process of counting randomly (Poisson) distributed fibers on a filter surface will give an S_r that depends on the number, N, of fibers counted:

$$S_r = 1/(N)^{1/2} \tag{1}$$

Thus S_r is 0.1 for 100 fibers and 0.32 for 10 fibers counted. The actual S_r found in a number of studies is greater than these theoretical numbers [17,19,20,21].

An additional component of variability comes primarily from subjective interlaboratory differences. In a study of ten counters in a continuing sample exchange program, Ogden [15] found this subjective component of intralaboratory S_r to be approximately 0.2 and estimated the overall S_r by the term:

$$\frac{[N + (0.2 \cdot N)^2]^{1/2}}{N} \tag{2}$$

Ogden found that the 90% confidence interval of the individual intralaboratory counts in relation to the means were +2 S_r and - 1.5 S_r. In this program, one sample out of ten was a quality control sample. For laboratories not engaged in an intensive quality assurance program, the subjective component of variability can be higher.

In a study of field sample results in 46 laboratories, the Asbestos Information Association also found that the variability had both a constant component and one that depended on the fiber count [14]. These results gave a subjective interlaboratory component of S_r (on the same basis as Ogden's) for field samples of ca. 0.45. A similar value was obtained for 12 laboratories analyzing a set of 24 field samples [21]. This value falls slightly above the range of S_r (0.25 to 0.42 for 1984-85) found for 80 reference laboratories in the NIOSH PAT program for laboratory-generated samples [17].

A number of factors influence S_r for a given laboratory, such as that laboratory's actual counting performance and the type of samples being analyzed. In the absence of other information, such as from an interlaboratory quality assurance program using field samples, the value for the subjective component of variability is chosen as 0.45. It is hoped that the laboratories will carry out the recommended interlaboratory quality assurance programs to improve their performance and thus reduce the S_r.

The above relative standard deviations apply when the population mean has been determined. It is more useful, however, for laboratories to estimate the 90% confidence interval on the mean count from a single sample fiber count (Figure 1). These curves assume similar shapes of the count distribution for interlaboratory and intralaboratory results [16].

For example, if a sample yields a count of 24 fibers, Figure 1 indicates that the mean interlaboratory count will fall within the range of 227% above and 52% below that value 90% of the time. We can apply these percentages directly to the air concentrations as well. If, for instance, this sample (24 fibers counted) represented a 500-L volume, then the measured concentration is 0.02 fibers/mL (assuming 100 fields counted, 25-mm filter, 0.00785 mm^2 counting field area). If this same sample were counted by a group of laboratories, there is a 90% probability that the mean would fall between 0.01 and 0.08 fiber/mL. These limits should be reported in any comparison of results between laboratories.

Note that the S_r of 0.45 used to derive Figure 1 is used as an estimate for a random group of laboratories. If several laboratories belonging to a quality assurance group can show that their interlaboratory S_r is smaller, then it is more correct to use that smaller S_r. However, the estimated S_r of 0.45 is to be used in the absence of such information. Note also that it has been found that S_r can be higher for certain types of samples, such as asbestos cement [9].

Quite often the estimated airborne concentration from an asbestos analysis is used to compare to a regulatory standard. For instance, if one is trying to show compliance with an 0.5 fiber/mL standard using a single sample on which 100 fibers have been counted, then Figure 1 indicates that the 0.5 fiber/mL standard must be 213% higher than the measured air concentration. This indicates that if one measures a fiber concentration of 0.16 fiber/mL (100 fibers counted), then the mean fiber count by a group of laboratories (of which the compliance laboratory might be one) has a 95% chance of being less than 0.5 fibers/mL; i.e., 0.16 + 2.13 x 0.16 = 0.5.

It can be seen from Figure 1 that the Poisson component of the variability is not very important unless the number of fibers counted is small. Therefore, a further approximation is to simply use +213% and -49% as the upper and lower confidence values of the mean for a 100-fiber count.

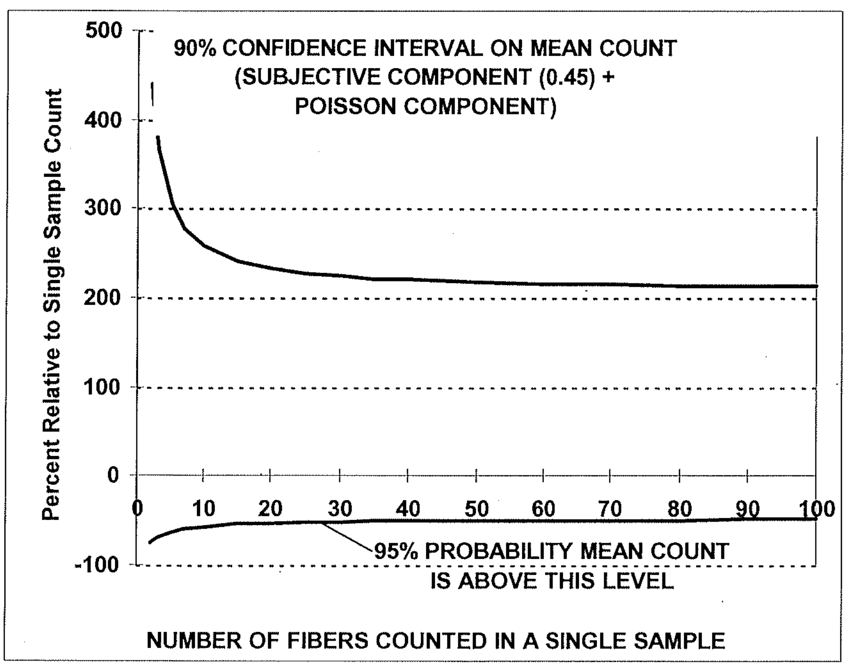

Figure 1. Interlaboratory Precision of Fiber Counts

The curves in Figures 1 are defined by the following equations:

$$UCL = \frac{2X + 2.25 + [(2.25 + 2X)^2 - 4(1 - 2.25 S_r^2) X^2]^{1/2}}{2(1 - 2.25 S_r^2)} \qquad (3)$$

$$LCL = \frac{2X + 4 - [(4 + 2X)^2 - 4(1 - 4 S_r^2) X^2]^{1/2}}{2(1 - 4 S_r^2)} \qquad (4)$$

where S_r = subjective interlaboratory relative standard deviation, which is close to the total interlaboratory S_r when approximately 100 fibers are counted.
X = total fibers counted on sample
LCL = lower 95% confidence limit.
UCL = upper 95% confidence limit.
Note that the range between these two limits represents 90% of the total range.

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APPENDIX A: CALIBRATION OF THE WALTON-BECKETT GRATICULE:

Before ordering the Walton-Beckett graticule, the following calibration must be done to obtain a counting area (D) 100 µm in diameter at the image plane. The diameter, d_c (mm), of the circular counting area and the disc diameter must be specified when ordering the graticule.

1. Insert any available graticule into the eyepiece and focus so that the graticule lines are sharp and clear.
2. Set the appropriate interpupillary distance and, if applicable, reset the binocular head adjustment so that the magnification remains constant.
3. Install the 40 to 45X phase objective.
4. Place a stage micrometer on the microscope object stage and focus the microscope on the graduated lines.
5. Measure the magnified grid length of the graticule, L_o (µm), using the stage micrometer.
6. Remove the graticule from the microscope and measure its actual grid length, L_a (mm). This can best be accomplished by using a stage fitted with verniers.
7. Calculate the circle diameter, d_c (mm), for the Walton-Beckett graticule:

$$d_c = \frac{L_a}{L_o} \times D. \qquad (5)$$

Example: If L_o = 112 µm, L_a = 4.5 mm and D = 100 µm, then d_c = 4.02 mm.

8. Check the field diameter, D (acceptable range 100 µm ± 2 µm) with a stage micrometer upon receipt of the graticule from the manufacturer. Determine field area (acceptable range 0.00754 mm² to 0.00817 mm²).

APPENDIX B: COMPARISON OF COUNTING RULES:

Figure 2 shows a Walton-Beckett graticule as seen through the microscope. The rules will be discussed as they apply to the labeled objects in the figure.

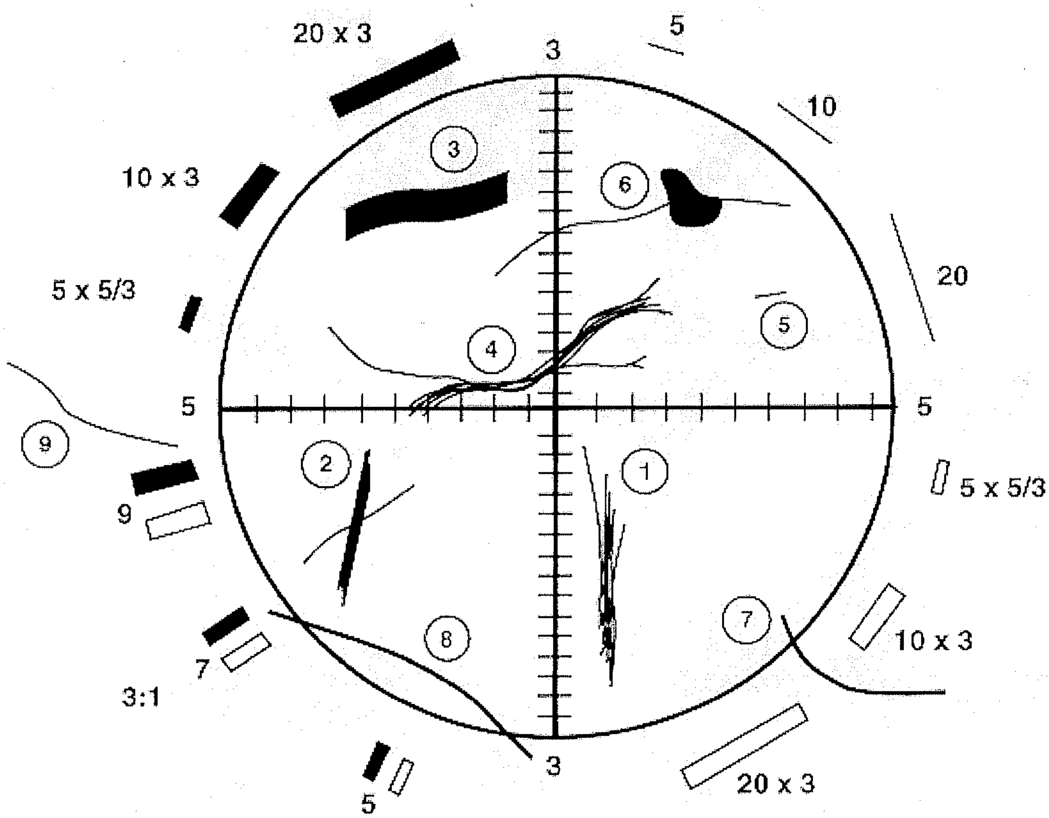

Figure 2. Walton-Beckett graticule with fibers.

These rules are sometimes referred to as the "A" rules.

FIBER COUNT

Object	Count	DISCUSSION
1	1 fiber	Optically observable asbestos fibers are actually bundles of fine fibrils. If the fibrils seem to be from the same bundle the object is counted as a single fiber. Note, however, that all objects meeting length and aspect ratio criteria are counted whether or not they appear to be asbestos.
2	2 fiber	If fibers meeting the length and aspect ratio criteria (length >5 µm and length-to-width ratio >3 to 1) overlap, but do not seem to be part of the same bundle, they are counted as separate fibers.
3	1 fiber	Although the object has a relatively large diameter (>3 µm), it is counted as fiber under the rules. There is no upper limit on the fiber diameter in the counting rules. Note that fiber width is measured at the widest compact section of the object.
4	1 fiber	Although long fine fibrils may extend from the body of a fiber, these fibrils are considered part of the fiber if they seem to have originally been part of the bundle.
5	Do not count	If the object is ≤5 µm long, it is not counted.
6	1 fiber	A fiber partially obscured by a particle is counted as one fiber. If the fiber ends emanating from a particle do not seem to be from the same fiber and each end meets the length and aspect ratio criteria, they are counted as separate fibers.
7	1/2 fiber	A fiber which crosses into the graticule area one time is counted as 1/2 fiber.
8	Do not count	Ignore fibers that cross the graticulate boundary more than once. count
9	Do not count	Ignore fibers that lie outside the graticule boundary.

APPENDIX C. ALTERNATE COUNTING RULES FOR NON-ASBESTOS FIBERS

Other counting rules may be more appropriate for measurement of specific non-asbestos fiber types, such as fibrous glass. These include the "B" rules given below (from NIOSH Method 7400, Revision #2, dated 8/15/87), the World Health Organization reference method for man-made mineral fiber [24], and the NIOSH fibrous glass criteria document method [25]. The upper diameter limit in these methods prevents measurements of non-thoracic fibers. It is important to note that the aspect ratio limits included in these methods vary. NIOSH recommends the use of the 3:1 aspect ratio in counting fibers.

It is emphasized that hybridization of different sets of counting rules is not permitted. Report specifically which set of counting rules are used with the analytical results.

"B" COUNTING RULES:

1. Count only <u>ends</u> of fibers. Each fiber must be longer than 5 µm and less than 3 µm diameter.
2. Count only ends of fibers with a length-to-width ratio equal to or greater than 5:1.
3. Count each fiber end which falls within the graticule area as one end, provided that the fiber meets rules 1 and 2 above. Add split ends to the count as appropriate if the split fiber segment also meets the criteria of rules 1 and 2 above.
4. Count visibly free ends which meet rules 1 and 2 above when the fiber appears to be attached to another particle, regardless of the size of the other particle. Count the end of a fiber obscured by another particle if the particle covering the fiber end is less than 3 µm in diameter.
5. Count free ends of fibers emanating from large clumps and bundles up to a maximum of 10 ends (5 fibers), provided that each segment meets rules 1 and 2 above.
6. Count enough graticule fields to yield 200 ends. Count a minimum of 20 graticule fields. Stop at 100 graticule fields, regardless of count.
7. Divide total end count by 2 to yield fiber count.

APPENDIX D. EQUIVALENT LIMITS OF DETECTION AND QUANTITATION

fiber density on filter*			fiber concentration in air, f/cc	
	fibers per 100 fields	fibers/mm²	400-L air sample	1000-L air sample
	200	255	0.25	0.10
	100	127	0.125	0.05
LOQ	80	102	0.10	0.04
	50	64	0.0625	0.025
	25	32	0.03	0.0125
	20	25	0.025	0.010
	10	12.7	0.0125	0.005
	8	10.2	0.010	0.004
LOD	5.5	7	0.00675	0.0027

* Assumes 385 mm^2 effective filter collection area, and field area = 0.00785 mm^2, for relatively "clean" (little particulate aside from fibers) filters.

SITE SPECIFIC HEALTH AND SAFETY PLAN

APPENDIX E

NIOSH ANALYTICAL METHOD 7402

ASBESTOS by TEM 7402

FORMULA: Various MW: Various CAS: Various RTECS: Various

METHOD: 7402	**EVALUATION: PARTIAL**	**Issue 1: 15 May 1989** **Issue 2: 15 August 1994**

OSHA : 0.1 asbestos fibers (>5 µm long)/cc; 1 f/cc/30 min excursion; carcinogen
MSHA: 2 asbestos fibers/cc
NIOSH: 0.1 f/cc (fibers > 5 µm long)/400 L; carcinogen
ACGIH: 0.2 crocidolite; 0.5 amosite; 2 chrysotile and other asbestos, fibers/cc; carcinogen

PROPERTIES: solid, fibrous, crystalline, anistropic

SYNONYMS [CAS#]: actinolite [77536-66-4] or ferroactinolite [15669-07-5]; amosite [12172-73-5]; anthophyllite [77536-67-5]; chrysotile [12001-29-5]; serpentine [18786-24-8]; crocidolite [12001-28-4]; tremolite [77536-68-6]; amphibole asbestos [1332-21-4].

SAMPLING

SAMPLER: FILTER (0.45- to 1.2-µm cellulose ester membrane, 25-mm diameter; conductive cassette)

FLOW RATE: 0.5 to 16 L/min

VOL-MIN*: 400 L @ 0.1 fiber/cc
-MAX*: (step 4, sampling)
*Adjust for 100 to 1300 fibers/mm^2

SHIPMENT: routine (pack to reduce shock)

SAMPLE STABILITY: stable

BLANKS: 2 to 10 field blanks per set

ACCURACY

RANGE STUDIED: 80 to 100 fibers counted

BIAS: not determined

OVERALL PRECISION ($\hat{S}_{rT}$): see EVALUATION OF METHOD

ACCURACY: not determined

MEASUREMENT

TECHNIQUE: MICROSCOPY, TRANSMISSION ELECTRON (TEM)

ANALYTE: asbestos fibers

SAMPLE PREPARATION: modified Jaffe wick

EQUIPMENT: transmission electron microscope; energy dispersive X-ray system (EDX) analyzer

CALIBRATION: qualitative electron diffraction; calibration of TEM magnification and EDX system

RANGE: 100 to 1300 fibers/mm^2 filter area [1]

ESTIMATED LOD: 1 confirmed asbestos fiber above 95% of expected mean blank value

PRECISION ($\bar{S}_r$): 0.28 when 65% of fibers are asbestos; 0.20 when adjusted fiber count is applied to PCM count [2].

APPLICABILITY: The quantitative working range is 0.04 to 0.5 fiber/cc for a 1000-L air sample. The LOD depends on sample volume and quantity of interfering dust, and is <0.01 fiber/cc for atmospheres free of interferences. This method is used to determine asbestos fibers in the optically visible range and is intended to complement the results obtained by phase contrast microscopy (Method 7400).

INTERFERENCES: Other amphibole particles that have aspect ratios greater than 3:1 and elemental compositions similar to the asbestos minerals may interfere in the TEM analysis. Some non-amphibole minerals may give electron diffraction patterns similar to amphiboles. High concentrations of background dust interfere with fiber identification. Some non-asbestos amphibole minerals may give electron diffraction patterns similar to asbestos amphiboles.

OTHER METHODS: This method is designed for use with Method 7400 (phase contrast microscopy).

REAGENTS:

1. Acetone. (See SPECIAL PRECAUTIONS.)

EQUIPMENT:

1. Sampler: field monitor, 25-mm, three-piece cassette with ca. 50-mm electrically-conductive extension cowl, cellulose ester membrane filter, 0.45- to 1.2-µm pore size, and backup pad.
   NOTE 1: Analyze representative filters for fiber background before use. Discard the filter lot if mean count is >5 fibers/100 fields. These are defined as laboratory blanks.
   NOTE 2: Use an electrically-conductive extension cowl to reduce electrostatic effects on fiber sampling and during sample shipment. Ground the cowl when possible during sampling.
   NOTE 3: 0.8-µm pore size filters are recommended for personal sampling. 0.45-µm filters are recommended for sampling when performing TEM analysis on the samples because the particles deposit closer to the filter surface. However, the higher pressure drop through these filters normally preclude their use with personal sampling pumps.
2. Personal sampling pump, 0.5 to 16 L/min, with flexible connecting tubing.
3. Microscope, transmission electron, operated at ca. 100 kV, with electron diffraction and energy-dispersive X-ray capabilities, and having a fluorescent screen with inscribed or overlaid calibrated scale (Step 15).
   NOTE: The scale is most efficient if it consists of a series of lines inscribed on the screen or partial circles every 2 cm distant from the center.
4. Diffraction grating replica with known number of lines/mm.
5. Slides, glass, pre-cleaned, 25- x 75-mm.
6. Knife, surgical steel, curved-blade.
7. Tweezers.
8. Grids, 200-mesh TEM copper, (optional: carbon-coated).
9. Petri dishes, 15-mm depth. The top and bottom of the petri dish must fit snugly together. To assure a tight fit, grind the top and bottom pieces together with an abrasive such as carborundum to produce a ground-glass contact surface.
10. Foam, clean polyurethane, spongy, 12-mm thick.
11. Filters, Whatman No. 1 qualitative paper or equivalent, or lens paper.
12. Vacuum evaporator.
13. Cork borer, (about 8-mm).
14. Pen, waterproof, marking.
15. Reinforcement, page, gummed.
16. Asbestos standard bulk materials for reference; e.g. SRM #1866, available from the National Institute of Standards and Technology.
17. Carbon rods, sharpened to 1 mm x 8 mm.
18. Microscope, light, phase contrast (PCM), with Walton-Beckett graticule (see method 7400).
19. Grounding wire, 22-gauge, multi-strand.
20. Tape, shrink- or adhesive-.

SPECIAL PRECAUTIONS: Acetone is extremely flammable (flash point = 0 °F). Take precautions not to ignite it. Heating of acetone must be done in a fume hood using a flameless, spark-free heat source. Asbestos is a confirmed human carcinogen. Handle only in a well-ventilated fume hood.

SAMPLING:

1. Calibrate each personal sampling pump with a representative sampler in line.
2. For personal sampling, fasten sampler to worker's lapel near worker's mouth. Remove the top cover from cowl extension ("open-face") and orient sampler face down. Wrap joint between extender and monitor body with tape to help hold the cassette together and provide a marking surface to identify the cassette. Where possible, especially at low %RH, attach sampler to electrical ground to reduce electrostatic effects during sampling.
3. Submit at least two field blanks (or 10% of the total samples, whichever is greater) for each set of samples. Remove top covers from the field blank cassettes and store top covers and cassettes in a clean area (e.g., closed bag or box) during sampling. Replace top covers when sampling is completed.
4. Sample at 0.5 to 16 L/min [3]. Adjust sampling rate, Q (L/min), and time, t (min), to produce fiber density, E, of 100 to 1300 fibers/mm^2 [$3.85 \cdot 10^4$ to $5 \cdot 10^5$ fibers per 25-mm filter with effective collection area (A_c= 385 mm^2)] for optimum accuracy. Do not exceed ca. 0.5 mg total dust loading on the filter. These variables are related to the action level (one-half the current standard), L (fibers/cc), of the fibrous aerosol being sampled by:

$$t = \frac{A_c \cdot E}{Q \cdot L \cdot 10^3}, \text{ min.}$$

   NOTE: The purpose of adjusting sampling times is to obtain optimum fiber loading on the filter. A sampling rate of 1 to 4 L/min for 8 h (700 to 2800 L) is appropriate in atmospheres containing ca. 0.1 fiber/cc in the absence of significant amounts of non-asbestos dust. Dusty atmospheres require smaller sample volumes ($\leq$400 L) to obtain countable samples. In such cases take short, consecutive samples and average the results over the total collection time. For documenting episodic exposures, use high rates (7 to 16 L/min) over shorter sampling times. In relatively clean atmospheres, where targeted fiber concentrations are much less than 0.1 fiber/cc, use larger sample volumes (3000 to 10000 L) to achieve quantifiable loadings. Take care, however, not to overload the filter with background dust [3].
5. At the end of sampling, replace top cover and small end caps.
6. Ship samples upright with conductive cowl attached in a rigid container with packing material to prevent jostling or damage.

   NOTE: Do not use untreated polystyrene foam in the shipping container because electrostatic forces may cause fiber loss from sample filter.

SAMPLE PREPARATION:

7. Remove circular sections from any of three quadrants of each sample and blank filter using a cork borer [4]. The use of three grid preparations reduces the effect of local variations in dust deposit on the filter.
8. Affix the circular filter sections to a clean glass slide with a gummed page reinforcement. Label the slide with a waterproof marking pen.

   NOTE: Up to eight filter sections may be attached to the same slide.
9. Place the slide in a petri dish which contains several paper filters soaked with 2 to 3 mL acetone. Cover the dish. Wait 2 to 4 min for the sample filter(s) to fuse and clear.

   NOTE: The "hot block" clearing technique [5] of Method 7400 or the DMF clearing technique [6] may be used instead of steps 8 and 9.
10. Transfer the slide to a rotating stage inside the bell jar of a vacuum evaporator. Evaporate a 1- by 5-mm section of a graphite rod onto the cleared filter(s). Remove the slide to a clean, dry, covered petri dish [4].
11. Prepare a second petri dish as a Jaffe wick washer with the wicking substrate prepared from filter or lens paper placed on top of a 12-mm thick disk of clean, spongy polyurethane foam [7].

Cut a V-notch on the edge of the foam and filter paper. Use the V-notch as a reservoir for adding solvent.

NOTE: The wicking substrate should be thin enough to fit into the petri dish without touching the lid.

12. Place the TEM grid on the filter or lens paper. Label the grids by marking with a pencil on the filter paper or by putting registration marks on the petri dish halves and marking with a waterproof marker on the dish lid. In a fume hood, fill the dish with acetone until the wicking substrate is saturated.

    NOTE: The level of acetone should be just high enough to saturate the filter paper without creating puddles.

13. Remove about a quarter section of the carbon-coated filter from the glass slide using a surgical knife and tweezers. Carefully place the excised filter, carbon side down, on the appropriately-labeled grid in the acetone-saturated petri dish. When all filter sections have been transferred, slowly add more solvent to the wedge-shaped trough to raise the acetone level as high as possible without disturbing the sample preparations. Cover the petri dish. Elevate one side of the petri dish by placing a slide under it (allowing drops of condensed acetone to form near the edge rather than in the center where they would drip onto the grid preparation).

CALIBRATION AND QUALITY CONTROL:

14. Determine the TEM magnification on the fluorescent screen:
    a. Define a field of view on the fluorescent screen either by markings or physical boundaries.
       NOTE: The field of view must be measurable or previously inscribed with a scale or concentric circles (all scales should be metric) [7].
    b. Insert a diffraction grating replica into the specimen holder and place into the microscope. Orient the replica so that the grating lines fall perpendicular to the scale on the TEM fluorescent screen. Ensure that goniometer stage tilt is zero.
    c. Adjust microscope magnification to 10,000X. Measure the distance (mm) between the same relative positions (e.g., between left edges) of two widely-separated lines on the grating replica. Count the number of spaces between the lines.
       NOTE: On most microscopes the magnification is substantially constant only within the central 8- to 10-cm diameter region of the fluorescent screen.
    d. Calculate the true magnification (M) on the fluorescent screen:

$$m = \frac{X \cdot G}{Y}$$

       where: X = total distance (mm) between the two grating lines;
       G = calibration constant of the grating replica (lines/mm);
       Y = number of grating replica spaces counted
    e. After calibration, note the apparent sizes of 0.25 and 5.0 µm on the fluorescent screen. (These dimensions are the boundary limits for counting asbestos fibers by phase contrast microscopy.)

15. Measure 20 grid openings at random on a 200-mesh copper grid by placing a grid on a glass slide and examining it under the PCM. Use the Walton-Beckett graticule to measure the grid opening dimensions. Calculate an average graticule field dimension from the data and use this number to calculate the graticule field area for an average grid opening.

    NOTE: A grid opening is considered as one graticule field.

16. Obtain reference selected area electron diffraction (SAED) or microdiffraction patterns from standard asbestos materials prepared for TEM analysis.

    NOTE: This is a visual reference technique. No quantitative SAED analysis is required [7]. Microdiffraction may produce clearer patterns on very small fibers or fibers partially obscured by other material.

    a. Set the specimen holder at zero tilt.

b. Center a fiber, focus, and center the smallest field-limiting aperture on the fiber. Obtain a diffraction pattern. Photograph each distinctive pattern and keep the photo for comparison to unknowns.

NOTE: Not all fibers will present diffraction patterns. The objective lens current may need adjustment to give optimum pattern visibility. There are many more amphiboles which give diffraction patterns similar to the analytes named on p. 7402-1. Some, but not all, of these can be eliminated by chemical separations. Also, some non-amphiboles (e.g., pyroxenes, some talc fibers) may interfere.

17. Acquire energy-dispersive X-ray (EDX) spectra on approximately 5 fibers having diameters between 0.25 and 0.5 µm of each asbestos variety obtained from standard reference materials [7].

NOTE: The sample may require tilting to obtain adequate signal. Use same tilt angle for all spectra.

a. Prepare TEM grids of all asbestos varieties.
b. Use acquisition times (at least 100 sec) sufficient to show a silicon peak at least 75% of the monitor screen height at a vertical scale of $\geq$500 counts per channel.
c. Estimate the elemental peak heights visually as follows:
   (1) Normalize all peaks to silicon (assigned an arbitrary value of 10).
   (2) Visually interpret all other peaks present and assign values relative to the silicon peak.
   (3) Determine an elemental profile for the fiber using the elements Na, Mg, Si, Ca, and Fe. Example: 0-4-10-3-<1 [7].

   NOTE: In fibers other than asbestos, determination of Al, K, Ti, S, P, and F may also be required for fiber characterization.

   (4) Determine a typical range of profiles for each asbestos variety and record the profiles for comparison to unknowns.

MEASUREMENT:

18. Perform a diffraction pattern inspection on all sample fibers counted under the TEM, using the procedures given in step 17. Assign the diffraction pattern to one of the following structures:
a. chrysotile;
b. amphibole;
c. ambiguous;
d. none.

NOTE: There are some crystalline substances which exhibit diffraction patterns similar to those of asbestos fibers. Many of these, (brucite, halloysite, etc.) can be eliminated from consideration by chemistry. There are, however, several minerals (e.g., pyroxenes, massive amphiboles, and talc fibers) which are chemically similar to asbestos and can be considered interferences. The presence of these substances may warrant the use of more powerful diffraction pattern analysis before positive identification can be made. If interferences are suspected, morphology can play an important role in making positive identification.

19. Obtain EDX spectra in either the TEM or STEM modes from fibers on field samples using the procedure of step 18. Using the diffraction pattern and EDX spectrum, classify the fiber:
a. For a chrysotile structure, obtain EDX spectra on the first five fibers and one out of ten thereafter. Label the range profiles from 0-5-10-0-0 to 0-10-10-0-0 as "chrysotile."
b. For an amphibole structure, obtain EDX spectra on the first 10 fibers and one out of ten thereafter. Label profiles ca. 0-2-10-0-7 as "possible amosite"; profiles ca. 1-1-10-0-6 as "possible crocidolite"; profiles ca. 0-4-10-3-<1 as "possible tremolite"; and profiles ca. 0-3-10-0-1 as "possible anthophyllite."

   NOTE: The range of profiles for the amphiboles will vary up to ± 1 unit for each of the elements present according to the relative detector efficiency of the spectrometer.

c. For an ambiguous structure, obtain EDX spectra on all fibers. Label profiles similar to the chrysotile profile as "possible chrysotile." Label profiles similar to the various amphiboles as "possible amphiboles." Label all others as "unknown" or "non-asbestos."

20. Counting and Sizing:

a. Insert the sample grid into the specimen grid holder and scan the grid at zero tilt at low magnification (ca. 300 to 500X). Ensure that the carbon film is intact and unbroken over ca. 75% of the grid openings.

b. In order to determine how the grids should be sampled, estimate the number of fibers per grid opening during a low-magnification scan (500 to 1000X). This will allow the analyst to cover most of the area of the grids during the fiber count and analysis. Use the following rules when picking grid openings to count [7,8]:

(1) Light loading (<5 fibers per grid opening): count total of 40 grid openings.

(2) Moderate loading (5 to 25 fibers per grid opening): count minimum of 40 grid openings or 100 fibers.

(3) Heavy loading (>25 fibers per opening): count a minimum of 100 fibers and at least 6 grid openings.

Note that these grid openings should be selected approximately equally among the three grid preparations and as randomly as possible from each grid.

c. Count only grid openings that have the carbon film intact. At 500 to 1000X magnification, begin counting at one end of the grid and systematically traverse the grid by rows, reversing direction at row ends. Select the number of fields per traverse based on the loading indicated in the initial scan. Count at least 2 field blanks per sample set to document possible contamination of the samples. Count fibers using the following rules:

(1) Count all particles with diameter greater than 0.25 µm that meet the definition of a fiber (aspect ratio ≥3:1, longer than 5 µm). Use the guideline of counting all fibers that would have been counted under phase contrast light microscopy (Method 7400). Use higher magnification (10000X) to determine fiber dimensions and countability under the acceptance criteria. Analyze a minimum of 10% of the fibers, and at least 3 asbestos fibers, by EDX and SAED to confirm the presence of asbestos. Fibers of similar morphology under high magnification can be identified as asbestos without SAED. Particles which are of questionable morphology should be analyzed by SAED and EDX to aid in identification.

(2) Count fibers which are partially obscured by the grid as half fibers.

NOTE: If a fiber is partially obscured by the grid bar at the edge of the field of view, count it as a half fiber only if more than 2.5 µm of fiber is visible.

(3) Size each fiber as it is counted and record the diameter and length:

(a) Move the fiber to the center of the screen. Read the length of the fiber directly from the scale on the screen.

NOTE 1: Data can be recorded directly off the screen in µm and later converted to µm by computer.

NOTE 2: For fibers which extend beyond the field of view, the fiber must be moved and superimposed upon the scale until its entire length has been measured.

(b) When a fiber has been sized, return to the lower magnification and continue the traverse of the grid area to the next fiber.

d. Record the following fiber counts:

(1) f_s, f_b = number of asbestos fibers in the grid openings analyzed on the sample filter and corresponding field blank, respectively.

(2) F_s, F_b = number of fibers, regardless of identification, in the grid openings analyzed on the sample filter and corresponding field blank, respectively.

CALCULATIONS:

21. Calculate and report the fraction of optically visible asbestos fibers on the filter, $(f_s - f_b)/(F_s - F_b)$. Apply this fraction to fiber counts obtained by PCM on the same filter or on other filters for which the TEM sample is representative. The final result is an asbestos fiber count. The type of asbestos present should also be reported.
22. As an integral part of the report, give the model and manufacturer of the TEM as well as the model and manufacturer of the EDX system.

EVALUATION OF METHOD:

The TEM method, using the direct count of asbestos fibers, has been shown to have a precision of 0.275 (s_r) in an evaluation of mixed amosite and wollastonite fibers. The estimate of the asbestos fraction, however, had a precision of 0.11 (s_r). When this fraction was applied to the PCM count, the overall precision of the combined analysis was 0.20 [2].

REFERENCES:

[1] Walton, W. H. "The Nature, Hazards, and Assessment of Occupational Exposure to Airborne Asbestos Dust: A Review," Ann. Occup. Hyg., 25, 115-247 (1982).

[2] Taylor, D. G., P. A. Baron, S. A. Shulman and J. W. Carter. "Identification and Counting of Asbestos Fibers," Am. Ind. Hyg. Assoc. J. 45(2), 84-88 (1984).

[3] Johnston, A. M., A. D. Jones, and J. H. Vincent. "The Influence of External Aerodynamic Factors on the Measurement of the Airborne Concentration of Asbestos Fibers by the Membrane Filter Method," Ann. Occup. Hyg., 25, 309-316 (1982).

[4] Zumwalde, R. D. and J. M. Dement. Review and Evaluation of Analytical Methods for Environmental Studies of Fibrous Particulate Exposures, NIOSH Technical Information Bulletin #77-204 (1977).

[5] Baron, P. A. and G. C. Pickford. "An Asbestos Sample Filter Clearing Procedure," Appl. Ind. Hyg., 1:169-171,199 (1986).

[6] LeGuen, J. M. and S. Galvin "Clearing and Mounting Techniques for the Evaluation of Asbestos Fibers by the Membrane Filter Method" Ann. Occup. Hyg. 24, 273-280 (1981).

[7] Yamate, G., S. A. Agarwal, and R. D. Gibbons. "Methodology for the Measurement of Airborne Asbestos by Electron Microscopy," EPA Contract No. 68-02-3266 (in press).

[8] Steel, E. B. and J. A. Small. "Accuracy of Transmission Electron Microcopy for the Analysis of Asbestos in Ambient Environments," Anal. Chem., 57, 209-213 (1985).

METHOD REVISED BY:

Paul A. Baron, Ph.D.; NIOSH/DPSE.

ATTACHMENT

MATERIAL SAFETY DATA SHEETS

(None Anticipated)

Health and Safety Plan Addendum

for

Troy Asbestos Property Evaluation (TAPE) and Removal Design Investigation (RDI)

HEALTH AND SAFETY PLAN

Troy Asbestos Property Evaluation

Contract No.	:	DEQ 402014-TO41
	:	
Date Prepared	:	3/25/10
Prepared by	:	Tetra Tech EM Inc. (Tetra Tech)
Date Reviewed	:	3/24/10
Reviewed by	:	Denny Cox
Tech Project Manager	:	J. Edward Surbrugg, Ph.D.
Telephone No.	:	(406) 442-5588

REVIEWS AND APPROVALS

CLIENT NAME: Montana Department of Environmental Quality
CONTRACT NO.: DEQ 402014-TO41

We the undersigned have read and approve of the health and safety guidelines presented in this health and safety plan for on-site work activities for the Troy Asbestos Property Evaluation project.

Name	Signature	Date
Denny Cox, Central Region Safety Officer		
J. Edward Surbrugg, Ph.D. Tetra Tech Project Manager	______________________________	________________

This certifies that Tetra Tech has assessed the type, risk level, and severity of hazards for the project and has selected appropriate personal protective equipment for site personnel in accordance with Occupational Safety and Health Administration Title 29 of the *Code of Federal Regulations*, Part 1910.132.

Certified by

Denny Cox, Central Region Safety Officer Tetra Tech Technical Reviewer	______________________________	________________

This addendum addresses items specified under Occupational Safety and Health Administration (OSHA) Title 29 of the *Code of Federal Regulations* (CFR), Part 1910.120 (b), “Final Rule.” and 29 CFR 1910.1001. The Troy Asbestos Property Evaluation (TAPE) health and safety plan (HASP) has not been modified since approved in its 5/18/09 version. This version remains unchanged and will continue to be used during the 2010 field season. The HASP will be available to all on-site personnel who may be exposed to hazardous on-site conditions, including Tetra Tech EM Inc. (Tetra Tech) and subcontractor personnel, and all site visitors and regulatory agency representatives. The site-specific health and safety provisions in this document have been developed for use during the Troy Asbestos Property Evaluation (TAPE) inspection and sampling as well as the 2010 Removal Design Inspection (RDI).

This HASP defines requirements and designates protocols to be followed during the TAPE and RDI inspection and sampling. All personnel on site, including Tetra Tech and subcontractor employees and site visitors, must be informed of site emergency response procedures and any potential health or safety hazards associated with on-site activities. This HASP summarizes potential hazards and defines protective measures planned for activities at the site.

This plan must be reviewed and approved by the Tetra Tech health and safety representative (HSR) or a designee and the Tetra Tech project manager (see the Reviews and Approvals form after the contents in this document). All personnel must sign the Compliance Agreement form in Appendix A before they enter the site. Protocols established in this HASP are based on site conditions and health and safety hazards known or anticipated to be present and on available site data. This plan is intended solely for use during proposed activities described in the corresponding site-specific work plan. Specifications are subject to review and revision based on actual conditions encountered in the field during site activities. The Tetra Tech project manager and the Tetra Tech HSR must approve significant revisions to this plan. Tetra Tech employees must also follow safety requirements taught during safety training and described in the Tetra Tech, Inc., “Health and Safety Manual” (1999).

TETRA TECH, INC.

HEALTH AND SAFETY PLAN COMPLIANCE AGREEMENT

Project Name: TAPE and Removal Design Inspection 2010

Project Number: ____________________

I have read and understand the health and safety plan indicated above and agree to comply with all of its provisions. I understand that I could be prohibited from working on the project for violating any of the safety requirements specified in the plan.

Name	Signature	Employer	Date

APPENDIX B

FIELD FORMS AND LABORATORY FORMS

Record of Modification
to the
Troy Sampling and Quality Assurance Project Plan
Field Activities
TFO-__ __ __ __ __ (numbered by Data Manager)

Instructions to Requester: **Fax to contacts at bottom of form for review and approval.**
File approved copy with Data Manager at the Troy Field Office (TFO).
Data Manager will maintain legible copies in a binder that can be accessed by TFO personnel.
If Modification is Temporary for a Single Parcel, Data Manager will scan this and place in parcel's electronic file.

Project Work Plan/QAPP (check one)**:**

- O Troy Removal Design Investigation WP/SAP
- O Other (Title and approval date):______________________________

Site-Specific Guidance/SOP (Number and Revision No.) (check one)**:**

- O Tetra Tech Aggressive Attic Inspection SOP
- O CDM-LIBBY-05, Current Revision (30-point soil sample collection)
- O CDM-LIBBY-06, Current Revision (Visible Vermiculite Estimation)

Other (Title, Number/Revision): ______________________________

Requester: ____________________ Title: ____________________
Company: ____________________ Date: ____________________

Description of Modification (attach additional sheets if necessary; state section and page numbers of each document that are affected by the proposed modification):______________________________

____

____

Field logbook and page number / FSDS where Modification is documented (or attach associated correspondence):

____

Potential Implications of Modification: ______________________________

____

____

Duration of Modification (check one):

- O Temporary
  - Date(s):__________________ AD-____________________
  - BD(s)-__________________ TT(s)-____________________
- O Permanent (Proposed Text Modification Section) Effective Date:__________________

Proposed Text Modifications in Associated Document (attach additional sheets if necessary):____________

____

____

Data Quality Indicator (circle one) – Please reference definitions on reverse side for direction on selecting data quality indicators:

Not Applicable **Reject** **Low Bias** **Estimate** **High Bias** **No Bias**

Technical Review and Approval: ______________________________ Date:______________
(DEQ Project Manager or designate)

EPA Review and Approval: ______________________________ Date:______________
(*USEPA RPM or designate*)

Revised March 25, 2010

DATA QUALITY INDICATOR DEFINITIONS

Reject - Samples associated with this modification form are not useable. The conditions outlined in the modification form adversely effect the associated sample to such a degree that the data are not reliable.

Low Bias - Samples associated with this modification form are useable, but results are likely to be biased low. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimated low.

Estimate - Samples associated with this modification form are useable, but results should be considered approximations. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimates.

High Bias - Samples associated with this modification form are useable, but results are likely to be biased high. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimated high.

No Bias - Samples associated with this modification form are useable as reported. The conditions outlined in the modification form suggest that associated sample data are reliable as reported.

APPENDIX C

STANDARD OPERATING PROCEDURES

STANDARD OPERATING PROCEDURES
FOR
TROY ASBESTOS PROPERTY EVALUATION
AGGRESSIVE ATTIC INSPECTION ACTIVITIES
TO VERIFY PRESENCE OR ABSENCE OF
VERMICULITE-CONTAINING INSULATION

Prepared for:

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY
Remediation Division
P.O. Box 200901
Helena, Montana 59620

Contract Number 407026
Contract Task Order Number 41

Prepared by:

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Helena, Montana 59601
(406) 442-5588

May 2009

TABLE OF CONTENTS

1.0 SCOPE OF WORK

The work specified in this Standard Operating Procedure (SOP) includes all procedures necessary to complete aggressive attic inspection activities in areas above ceilings of primary and secondary buildings during the Troy Asbestos Property Evaluation (TAPE) inspections. These procedures supplement existing TAPE attic inspection procedures outlined in Section 4.4.1 of the TAPE Work Plan and Section 9.1 of the Health and Safety Plan in which attic access was limited to field technicians' torso levels. Libby amphibole (LA) can not be identified by visual inspection; therefore, field technicians will look specifically for vermiculite-containing insulation (VCI) during the attic inspections. All forms of vermiculite identified in attics, including expanded or unexpanded material will be deemed "VCI" by the field inspectors. The existing TAPE attic inspection procedures were sufficient to determine the presence or absence of VCI in most attics, but were not aggressive enough to determine the presence of VCI in all attics. The more aggressive procedures described in this SOP will be needed when there are limited attic access locations and the entire attic space can not be adequately inspected from the available access hatch locations. This SOP addresses attic inspection activities in partially finished or unfinished attics when a field technician is required to enter the attic with his/her full body. Such work includes, but is not limited to: installation of work area isolation and engineering controls; inspection activities as specified in this document; and equipment and personal decontamination procedures. All potential asbestos-related VCI inspection activities must be performed in compliance with applicable federal, state, and local regulations, and this document.

2.0 GENERAL TECHNICAL REQUIREMENTS

This section describes the general technical requirements for attic inspection procedures and provides guidelines for performing the work. All sections of this SOP shall be used when Tetra Tech EMI, Inc. (Tetra Tech) field personnel are performing aggressive attic inspections.

2.1 PERSONAL DOCUMENTATION REQUIREMENTS

- AHERA Contractor/Supervisor or Worker training certificates for all field technicians.
- Personnel respirator fit test records.
- Personnel medical examination records.

2.2 ISOLATION AND ENGINEERING CONTROLS

- Deactivate or isolate the HVAC system servicing the staging room.
- Seal passive air return grilles with one layer of polyethylene sheeting.
- Use fire resistant polyethylene sheeting materials.
- Install and activate a high efficiency particulate air (HEPA) filtered 600 cfm air filtration unit at an attic vent furthest from the access hatch point of entry, The unit will be activated once the access hatch is opened and remain running until decontamination procedures are completed.

2.3 POLYETHYLENE SHEETING

- Use fire resistant polyethylene sheeting materials.
- Use one layer of 6 mil on the floor and walls of the staging chamber.
- Use one layer of 6 mil over the passive HVAC return duct grills in the staging room.
- Use one layer of 6 mil on the floor outside the staging chamber.

2.4 EQUIPMENT

- Personal Protective Equipment (PPE)
- HEPA vacuum
- Polyethylene sheeting
- Asbestos disposal bags
- Ladder
- 600 cfm air filtration unit
- Water misting sprayer
- Duct tape and painter’s tape
- Disposable towels
- 5-gallon wash basin
- Flashlight and electric lights
- Support planks
- Camera
- Staging chamber

2.5 STAGING CHAMBER CONSTRUCTION

- A staging chamber shall be used for interior accessed aggressive attic inspections only. Staging chambers will not be required when accessing attics from the exterior of the buildings.
- The staging chamber will consist of a single stage “pop up” design mini-containment and will serve as the clean room, wash area and equipment room. The staging chamber shall be large enough to house a ladder and all necessary equipment. Modified staging chamber designs may be installed on site in areas where a pop up units can not be used; for example at stairways or within closets.
- The staging chamber will be installed at the base of the interior attic access hatch. A staging chamber will not be required when an exterior access hatch is used.
- A wash basin decontamination system shall be used inside the staging chamber.
- Equipment and waste decontamination will be completed inside the staging chamber.

2.6 PERSONAL PROTECTIVE EQUIPMENT

- The minimum respiratory protection required shall be half-face air purifying respirators upon successful completion of a negative exposure assessment (NEA), or upon providing of documentation meeting the requirements of 29 CFR 1926.1101 showing personnel air sampling data which justifies this level of respiratory protection.
- Prior to a successful NEA, all initial aggressive attic inspections shall be performed using powered air purifying respirators or full-face negative pressure respirators.
- Disposable outer garments such as Tyvek or polypropylene coveralls including head/foot coverings shall be worn. Inspectors shall use a double suit method.
- Protective eyewear should be worn if powered air purifying respirators or full face respirators are not used.
- Bump caps or hardhats and knee pads should be worn.

2.7 TRAINING

- A certified contractor/supervisor shall be on-site at all times during aggressive attic inspections. Training for the contractor/supervisor must meet the requirements of 29 CFR 1926.32 (f) and the EPA's Model Accreditation Plan (40 CFR 763).
- Field technicians who conduct aggressive attic inspections must have completed either AHERA worker training or contractor/supervisor training. Worker training must also meet the requirements of 29 CFR 1926.32. The minimum worker training must be a 32-hour OSHA-approved course.

2.8 AIR MONITORING BY TETRA TECH

- Tetra Tech will conduct personnel exposure air monitoring assessments using the OSHA compliance method (National Institute of Safety and Health [NIOSH] 7400 phase contrast microscopy [PCM]) during the first attic inspections of the field season and periodically throughout the remainder of the field season. Tetra Tech will discontinue or modify the procedures if fiber levels exceed limits of 0.1 fibers per cubic centimeter of air (f/cc) inside the attic or 0.01 f/cc in the staging chamber outside the attic. Work stoppage may also be required if other health and safety related issues are identified that could lead to injury of workers.
- At the onset of the field season, Tetra Tech will collect background air samples to establish baseline airborne fiber levels in the staging rooms prior to beginning the work. Samples will be collected for transmission electron microscopy (TEM) analysis and will be archived during the project. Background sample analysis by TEM will only be required if perimeter stationary air sample results exceed the specified requirements of 0.01 f/cc by the PCM analytical method.
- Tetra Tech will collect perimeter stationary air samples using a PCM method during the initial aggressive attic inspection procedures to document airborne fiber levels outside the staging chambers and in the staging rooms. The results will be provided the same day, or at a minimum of 24-hour turn-around time. The sensitivity of the PCM method is limited, making asbestos fibers difficult to distinguish from non-asbestos fibers. NIOSH Method 7400 will be used to analyze air samples by PCM. This method does not accurately distinguish between asbestos and non-asbestos fibers and simply considers any fiber with a length-to-width ratio of 3:1 to be an asbestos fiber. Therefore, the PCM method will be used to document the general cleanliness of aggressive attic access procedures.
- Air samples will be collected to monitor airborne asbestos fibers levels in a work area. Samples will be collected using personal monitoring pumps or larger-volume floor pumps. The samples will be used to establish the respiratory protection requirements for workers. Air samples will also be collected after a response action or abatement project to evaluate whether the work area has been adequately cleaned.

2.9 GENERAL SAFETY HAZARDS

- Assess each building for general safety hazards before entering attics and avoid attic entry if safety is in jeopardy.
- Insects and nests: Have the property owners use wasp/hornet spray to kill insects and nests prior to accessing attic areas. A waiting period may be required after application to ensure that nests have been abandoned. Cover all skin surfaces with PPE. Avoid access if safety is in jeopardy.
- Photo document the existing condition of the attic access hatch and ceilings prior to the attic entry. Note any existing cracks or other damage to the ceilings and discuss the presence with the property owner prior to the attic entry.
- Rodents/animals: Cover all skin surfaces with PPE. Avoid disturbing droppings and wear respirators at all times. Avoid access if safety is in jeopardy.

- Broken joist or unstable ceilings: Assess ceilings prior to and during attic access and avoid access if safety is in jeopardy.
- Electrical wiring: Avoid all electrical wiring and assume that all wiring is potentially hazardous. Avoid access if safety is in jeopardy.
- Exposed nails: Beware of nails at all times. Wear head, eye, hand and knee protection at all times.
- Unstable objects or debris: Avoid disturbing objects or debris stored in the attic. Do not relocate items stored inside the attics when moving about.
- High temperature hazards: High temperatures will present safety hazards during the summer season. Aggressive attic access procedures should be scheduled during morning hours whenever possible. Attic inspections should be limited to no more than 10 minutes. Operate an air filtration unit for at least 10 minutes prior to accessing excessively hot attics to provide cooling and fresh air intake. Safe Work Practices 6-15 and 6-16 discuss heat and cold stress and include monitoring methods appropriate for the season and location of work (see Appendix B of the TAPE HASP).

2.10 PROPERTY DAMAGE AND OTHER EMERGENCIES

- Ceiling Damage: Assess the condition of all ceilings before beginning the inspection procedures and avoid access if safety is in jeopardy. The second technician remaining below the ceiling should inspect the ceilings throughout the inspection process to ensure that damage does not occur. Notify the owner in all cases if ceiling damage occurs during the inspection procedure. If a ceiling breach occurs, discontinue the inspection procedure immediately and get off of the ceiling. If non-VCI debris falls into the living spaces, seal the ceiling breach and clean up the debris immediately. The owners will be informed that the TAPE DEQ representative will be contacting them and full damage repairs will be made. If VCI debris falls into the living space, notify the TAPE field manager immediately. Request that the property owner vacate the affected room(s) during the cleanup procedure. Isolate the effected/contaminated room with polyethylene critical barriers on doors and HVAC ducts. Seal the ceiling breach, wet wipe, and HEPA vacuum all contaminated debris. The TAPE field manager will supervise cleaning of the effected room(s) and will collect air clearance samples prior to recommending that the property owner re-occupy the area. A detailed incident report, including photographic documentation, should be compiled throughout the process. The owner will be informed that the TAPE DEQ representative will be contacting them to discuss the extent of repairs to be made.
- Health & Safety Emergency: If an injury occurs to an inspection team member during a procedure, discontinue the inspection immediately and leave the attic. If the injury is serious and emergency medical assistance is required, call 911 immediately and then notify the TAPE field office and TAPE field manager.

2.11 FACILITIES

- Electrical power will be supplied by the property owner.

- Water will be brought on-site by Tetra Tech. Water for decontamination procedures will be containerized in Hudson sprayers and/or sealable 5-gallon buckets.

2.12 TRANSPORTATION AND DISPOSAL

- Tetra Tech will transport and dispose of all contaminated materials in accordance with all applicable federal, state, and local regulations.

2.13 PREPARATION

- Two inspection team members are required for this procedure.
- Post warning signs at entrances to the staging chamber.
- Install staging chamber and ladder at base of the interior attic access hatch.
- Install a high efficiency particulate air (HEPA) filtered 600 cfm air filtration unit at an attic vent furthest from the access hatch point of entry.
- Cover as large an area as possible (up to 6 feet by 6 feet floor area) under the work area with 6-mil polyethylene sheeting.
- Prepare an asbestos disposal bag and bag any waste that is generated.
- Don 2 layers of Tyvek or polypropylene overalls, gloves, respirator, and other PPE.
- Use high-powered flashlights during all attic inspection procedures.

2.14 EXECUTION

- Set up ladder inside the staging chamber. Seal a polyethylene sheeting flap from the top of the staging chamber to outside of the access hatch using painter's tape or duct tape. Care should be taken to apply tape to surfaces without damaging paint or ceiling texture.
- Remove access hatch carefully by placing it atop an adjacent ceiling area. HEPA vacuum any gross debris on top of the access hatch.
- The 600 cfm air filtration unit will be activated once the access hatch is opened and remain running until decontamination procedures are completed.
- If VCI is observed at any point during the attic inspection, the inspection team member will promptly complete the visual inspection of the attic from that point and leave the attic.
- Wet any big pieces of VCI debris that falls from the attic with a Hudson sprayer and place it in the asbestos disposal bag.
- Install adequate lighting to ensure safe access in the attic.
- Perform the inspection work in the attic being careful to remain on top of the ceiling joists at all times. The inspectors should rotate 2 or 3 (10-inch by 3-foot) planks on top of the ceiling joists to support their weight when moving within the attic. While kneeling on the planks wearing knee pads, the inspectors should support their weight evenly centered between the ceiling joists at all times.

2.15 CLEAN-UP

- The following clean-up practices will be employed for all attic inspections regardless of presence of VCI.
- Wet wipe the ladder and tools that were used to perform the inspection work.
- While inside the staging chamber, HEPA vacuum coveralls after descending the ladder. Remove coveralls and place in an asbestos disposal bag.
- Wet wipe the interior of the staging chamber before disassembly or removal from the site.
- Wet wipe hands, face and exposed PPE with wet towels prior to removing respirator.
- Remove respirator and wipe the respirator with a wet rag. Place the respirator into a bag. Later, clean the respirator according to the procedure outlined in the respiratory protection section of the TAPE HASP.
- Mist, roll, and place the polyethylene sheeting in the asbestos disposal bag.
- Detach and de-activate the 600 cfm air filtration unit from the attic vent. Seal the contaminated inlet side of the unit with polyethylene sheeting and duct tape before transporting it.
- Double bag all waste.
- Dispose of all LA asbestos contaminated waste in accordance with all applicable Federal, State, and Local regulations.

3.0 PROCEDURAL SEQUENCING

The following provides a recommended progression of the work at the site:

1) Use exterior access hatches first when they are available.

2) Photo document the existing condition of access hatches and ceilings throughout the inspection area. Note any existing cracks or other damage to the ceilings and discuss their presence with the property owner prior to the attic entry.

3) Shut down all heating and air conditioning units and keep them “off” throughout inspection activities. Seal the air supply and return ductwork serving the staging room with airtight and watertight critical barriers.

4) Install the staging chamber below the interior access hatch. If the access hatch is located inside a closet or another location where personal items must be moved prior to installing the chamber, request permission from the owner to move and/or cover items with polyethylene sheeting before starting set up. Take photos of existing conditions prior to disturbing any personal items and be sure to replace all items appropriately upon completion of the inspection procedures.

5) Conduct personnel exposure assessments air sampling to document a negative exposure assessment at the beginning of the field season attic inspections and periodically during the season. Personnel air monitoring will be collected during multiple inspections the first day to determine an 8-hour time weighted average (TWA) as well as a 30-minute short term exposure limit (STEL). Personnel air monitoring samples will be analyzed on a 24-hour turnaround basis. Initial negative exposure assessments will be conducted to document at least one attic with VCI.

6) Conduct stationary air sampling in areas adjacent to the staging chamber during the initial inspections of the field season and periodically during the season. Stationary air monitoring samples will be analyzed on a 24-hour turnaround basis. Initial stationary air monitoring will be conducted to document at least one attic inspection with VCI.

7) Install and activate a HEPA filtered 600 cfm air filtration unit at an attic vent furthest from the access hatch point of entry. The unit will be activated once the access hatch is opened and remain running until decontamination procedures are completed. Operate the air filtration unit for at least 10 minutes prior to accessing excessively hot attics to provide cooling and fresh air intake.

8) Conduct a preparation inspection of the work area to ensure containment integrity prior to starting the aggressive attic inspection.

9) Containerize debris routinely during aggressive attic inspection activities. Exercise caution to avoid tracking contamination from the attic to the “clean” staging chamber or staging room.

10) Once the inspection is finished, complete decontamination as outlined in Section 2.15.

Site-Specific Sampling Guidance
Libby Superfund Site

Guidance No.: <u>CDM-LIBBY-05, Revision 3</u>

Guidance Title: Soil Sample Collection at Residential and Commercial Properties

Approved by:

Project Manager	Date
Technical Reviewer	Date
QA Reviewer	Date
EPA Approval	Date

Section 1 Purpose

The goal of this standard operating procedure (SOP) is to provide a consistent method for the collection of 30-point composite surface soil sampling to support all investigations conducted at the Libby Superfund Site and specified in governing guidance documents. This SOP describes the equipment and operations used for sampling surface soils in residential and commercial areas, which will be submitted for the analysis of Libby amphibole asbestos. Refer to each investigation-specific guidance documents or work plan for detailed modifications to this SOP, where applicable. The EPA Team Leader or their designate must approve deviations from the procedures outlined in this document prior to initiation of the sampling activity.

Section 2 Responsibilities

Successful execution of this SOP requires a clear hierarchy of assigned roles with different sets of responsibilities associated with each role. All staff with responsibility for the collection of soil samples is responsible for understanding and implementing the requirements contained herein as well as any other governing guidance documents.

<u>Task Leader (TL) or Field Team Leader (FTL) -</u> The TL or FTL is responsible for overseeing sample collection processes as described in EPA approved governing guidance documents (i.e., site-specific sampling and analysis plans [SAPs], quality assurance project plans [QAPPs], etc.). The TL or FTL is also responsible for checking all work performed and verifying that the work satisfies the specific tasks outlined by this SOP and all governing guidance documents. The TL or FTL will communicate with the field team members regarding the specific collection objectives and anticipated situations that require deviation from this SOP. It is also the responsibility of the TL or FTL to communicate the need for any deviations from the SOP with the appropriate EPA personnel (team leader or their designate), and document the deviations using a Field Modification Form provided in each SAP or QAPP.

<u>Field team members</u> - Field team members performing the sampling described in this SOP are responsible for adhering to the applicable tasks outlined in this procedure while collecting samples at properties associated with the Libby Superfund Site. The field team members should have limited discretion with regard to collection procedures but should exercise judgment regarding the exact location of sample points, within the boundaries outlined by the TL or FTL.

Section 3
Equipment

- Measuring tape or wheel – Used to estimate the square footage of each land use area.
- Pin flags – Used to identify composite points within each sampling area.
- Trowel or push probe - For collecting surface soil samples.
- Shovel - For collecting surface soil samples.
- Stainless steel mixing bowl - Used to mix and homogenize composite soil samples after collection. Zip-top bags may also be used for homogenization if approved by the governing guidance documents.
- Gloves - For personal protection and to prevent cross-contamination of samples (disposable, powderless plastic or latex).
- Sample container - Gallon-sized zip-top plastic bags (2 per sample).
- Field clothing and personal protective equipment (PPE) - As specified in the current version of the site health and safety plan (HASP).
- Field sprayers – Used to suppress dust during sample collection and to decontaminate nondisposable sampling equipment between samples.
- Deionized (DI) water- Used in field sprayers to suppress dust and to clean and decontaminate sampling equipment.
- Plastic bristle brush - Used to clean and decontaminate sampling equipment.
- Wipes - Disposable, paper. Used to clean and decontaminate sampling equipment.
- Aluminum foil – Used to wrap decontaminated sampling equipment in between uses to prevent contamination during transport.
- Alconox – Used to clean and decontaminate sampling equipment weekly.
- 6-mil poly bag – Used to store and dispose of investigation-derived waste (IDW).
- Trash bag - Used to store and dispose of general trash.
- Field logbook/PDA - Used to record progress of sampling effort and record any problems and field observations.

- Visual Vermiculite Estimation Form (VVEF) – Used to record semi-quantitative estimates of visual vermiculite at each sub-sample location and point inspection (PI).

- Permanent marking pen - Used to label sample containers.

- Sample ID Labels (Index IDs)– Pre-printed stickers used to label sample containers.

- Cooler or other rigid container - Used to store samples while in the field.

- Custody Seals - For ensuring integrity of samples while in the field and during shipping.

Section 4
Sampling Approach

Upon arrival at each property, the field team will locate all parcels requiring sample collection depending on the investigation-specific objectives detailed in governing guidance documents. Parcels on a property will be sectioned into zones that share a similar land use. Zones established by land use areas may be subdivided based on site conditions (e.g., access, construction setup considerations, etc.). Use areas include:

- Specific Use Area (SUA): flowerbed, garden, flowerpot, stockpile, play area, dog pen, driveway (non-paved), parking lot (non-paved), road (non-paved), alley (non-paved)

- Common Use Area (CUA): yard, former garden, former flowerbed, walkway

- Limited Use Area (LUA): pasture, maintained/mowed field, overgrown areas with trails/footpaths, overgrown areas in between SUAs/CUAs

- Interior Surface Area (ISA): soil floor of garage, pumphouse, shed, crawlspace, earthen basement

- Non-Use Areas(NUA): wooded lot, un-maintained field. NUAs will be identified but will not be sampled at this time because they are not presently considered a complete exposure pathway. However, to the extent that NUAs may become a complete exposure pathway in the future, EPA may revisit NUAs at a later date.

After areas have been designated as zones (i.e., SUA zones, CUA zones, LUA zones, NUA zones, ISA zones), the field team will measure the zones with a measuring wheel and label the zone type and approximate square footage on the field sketch and/or design drawings. There is not a minimum or maximum square footage restriction on any zone.

In establishing zones at the property, no area type may be combined with any other area type. For example, driveways and flowerbeds are both SUAs but will be separated into unique zones for soil sampling. Similarly, large CUAs such as yards may be subdivided into front yard, side yard, and back yard zones dependent on site conditions. Sectioning properties into additional zones will be at the discretion of the FTL but consistent among the teams. Conversely, not all land use areas previously mentioned will be applicable at every property.

It is anticipated that SUAs and ISA zones will generally tend to be smaller parcels. Combining small, proximal SUAs into one zone will be at the discretion of the FTL but consistent among teams. With the exception of proximal SUAs, all other land use areas will be contiguous when establishing zones at each property.

Composite sampling requires soil collection from multiple (sub-sample) points. Composite samples will be collected from similar land use areas (i.e., SUA, CUA, etc.) and will not be combined with any other use area. One composite sample will be collected from each zone.

For SUAs (e.g., driveway, garden, dog pen, etc.), composite samples will be collected from the 0- to 6–inch depth interval. If a depth of 6 in. cannot be attained given the varying levels of compaction in driveways, roads, etc. the maximum depth attainable will be documented in the field logbook/PDA. For non-SUAs (e.g., yard, former flowerbed, crawlspace, etc.), composite samples will be collected from 0 to 3 inches. All composite soil samples will have 30 sub-samples (i.e., 30-point composite sample) of approximately equal size for a final sample volume between 2,000 and 2,500 grams. Table 1 lists the sample depth for each type of land use area.

TABLE 1
SAMPLING AREA AND DEPTH

Land Use Area	Label	Sampling Depth (Inches)
Special Use Area	SUA	0 – 6
Common Use Areas	CUA	0 – 3
Limited Use Area	LUA	0 – 3
Non-Use Area	NUA	Not Sampled
Interior Surface Zone	IS	0 – 3

As each sub-sample is collected, the soil will be inspected for visual vermiculite (VV) and the location and semi-quantitative estimates of VV will be recorded as prescribed in the SOP for Semi-Quantitative Visual Estimation of Vermiculite in Soil, Revision 1 (CDM 2007a).

Areas of SUAs with VV will not be sampled. Instead, the location will be recorded in the field logbook/PDA and on the field sketch or design drawing. If the SUA is of substantial size (greater than 1000 square feet [ft^2]), and the VV is localized, additional PIs will be collected to determine the extent of VV and a sample will be collected from the remainder of the zone that does not contain VV. If the SUA measures less than 1,000 ft^2 and VV is present, a sample will not be collected from that SUA. Proximal SUAs will not be combined into a SUA zone if VV is present. If visible vermiculite is not observed, proceed with sample collection of the SUA zone

Section 5
Sample Collection

Don the appropriate PPE as specified in the governing HASP. A new pair of disposable gloves is to be worn for each sample collected. Segregate land use areas on the property into zones as described in Section 4. To reduce dust generation during sampling, use a sprayer with DI water to wet each sub-sample location prior to collection. Use the trowel to check beneath the surface soil layer, but do not advance more than 6 inches. If VV is observed, record the information on the field sketch or design drawing. If VV is observed within a large SUA, do not collect a sample from the area containing VV as described above.

Within each zone, select 30 sub-sample locations equidistant from each other. These 30 sub-sample locations will comprise the 30-point composite sample for that zone. All composite sub-samples will originate from the same land use area. For example, do not mix sub-samples from SUAs with sub-samples from LUAs.

Clean the sub-sample locations of twigs, leaves, and other vegetative material that can be easily removed by hand. Using the trowel or push probe, excavate a hole in the soil approximately 2 inches in diameter and 6 inches deep for SUAs, or 3 inches deep for non-SUAs, while placing the excavated material directly inside the gallon-sized zip-top plastic bag. Repeat this step for each subsequent sub-sample until the appropriate number of composite sub-samples has been collected. As each sub-sample is collected, inspect the location for VV as prescribed in the SOP for Semi-Quantitative Visual Estimation of Vermiculite in Soil, Revision 1 (CDM 2007a).

Samples collected from zones measuring greater than 3,000 ft^2 will require additional PIs to inspect the soil for VV, but no more than 30 sub-samples will be collected from a zone for each composite sample. Samples collected from zones measuring less than 3,000 ft^2 will have the same number of sub-samples as PIs unless additional PIs are required to identify the extent of localized VV.

Homogenize the sample as required by governing guidance documents. Once the sample is homogenized, fill the zip-top plastic bag to 1/3rd full (approximately 2000 grams). Affix the sample index ID label to the inside of the bag and write the index ID number on the outside of the bag, or affix an additional label using clear packing tape. Sample index ID numbers will be assigned based on the investigation-specific guidance document. Double bag the sample and repeat the labeling process for the outer bag. Decontaminate equipment between composite samples as described in Section 8.

Repeat steps outlined above until all samples from a property have been collected.

Soil field duplicate samples will be collected at the rate specified in governing guidance documents. Field duplicate samples will be collected as samples co-located in the same zone. The duplicate will be collected from the same number of sub-samples as the parent sample, but the sub-sample locations of the duplicate sample will be randomly located in the zone. The inspection for VV at each sub-sample location will follow the same protocol as referenced above. These samples will be independently collected with separate sampling equipment or with the original sampling equipment after it has been properly decontaminated. For tracking purposes, the parent/duplicate sample relationship will be recorded in accordance with sample documentation requirements stated in the governing guidance document. These samples will be used to determine the variability of sample results in a given land use area. These samples will not be used to determine variability in sampling techniques.

Section 6
Site Cleanup

IDW will be managed as prescribed in Section 3.2.10 of the Site-wide QAPP [SWQAPP] (CDM 2007b) or other applicable governing guidance documents. In general, replace the soil plug with excess sample volume. The soil should be placed back into the hole and tamped down lightly. If sandy areas such as playgrounds are sampled, refilling the soil plug is not necessary.

Rinse water, the roots of vegetation removed during sampling, and any excess soil volume may be returned to the sampled area.

Section 7
Documentation

A field logbook/PDA will be maintained by each individual or team that is collecting samples as prescribed in Section 3.2.4 of the SWQAPP (CDM 2007b) or other applicable governing guidance documents. Guidance documents will detail conditions which require attention, but at a minimum the following information should be collected:

- Project name
- Title of governing documents
- Property address
- Date
- Time

- Team members
- Weather conditions
- PPE used
- Locations of any samples or sub-samples that could not be acquired
- Descriptions of any deviations to the SAP or SOP and the reason for the deviation
- Relinquishment of samples to project sample coordinator

Complete required documentation as detailed in applicable governing guidance documents.

Section 8
Quality Assurance/Quality Control

Quality control samples will include:

- Field duplicates

Detailed information on QC sample collection and frequency is prescribed in Section 3.1.3.2 of the SWQAPP (CDM 2007b) or other applicable governing guidance documents.

Section 8
Decontamination

All sampling equipment must be decontaminated prior to reuse. Specific instructions on sample equipment decontamination are included in the applicable governing guidance documents. In general, the procedure to decontaminate all soil sampling equipment is outlined below:

- Remove all visible contamination with plastic brush
- Use DI water and plastic brush to wash each piece of equipment
- Remove excess water present on the equipment by shaking
- Use a paper towel to dry each piece of equipment
- Wrap dried equipment in aluminum foil

Once a week all soil sampling equipment will be cleaning using Alconox and DI water.

Spent wipes, gloves, aluminum foil, and PPE must be disposed of or stored properly as IDW, specified in Section 3.2.10 of the SWQAPP (CDM 2007b) or other applicable governing guidance documents.

Section 9
Sample Custody

Field sample custody and documentation will follow the requirements described in Section 3.2.11 of the SWQAPP (CDM 2007b) or other applicable governing guidance documents.

Section 10
Glossary

Governing guidance documents - The written document that spells out the detailed site-specific procedures to be followed by the project leader and the field personnel for completing specific investigations. These documents will clearly indicate specific requirements for the implementation of this SOP.

Libby Superfund Site – The Libby Superfund Site contains all buildings and land within the boundaries of each operable unit (OU) of the site and illustrated on the most recent version of the OU boundary map.

Sub-sample - The actual location at which the sample is taken. The dimension of a sample point is 2 inches across by 3 inches deep (6 inches for SUAs).

Composite Sampling - A sample program in which multiple sample points are compiled together and submitted for analysis as a single sample.

Land Use Area - A section of property segregated by how the property owner uses the area. The area can be classified as a SUA, LUA, CUA, ISA, or NUA.

Section 11
References

CDM. 2007a. Semi-Quantitative Visual Estimation of Vermiculite in Soils at Residential and Commercial Properties, Revision 1. CDM-LIBBY-06.

CDM. 2007b. Site-Wide Quality Assurance Project Plan. Draft in review.

Site-Specific Sampling Guidance
Libby Superfund Site

SOP No.: CDM-LIBBY-06, Revision 1

SOP Title: Semi-Quantitative Visual Estimation of Vermiculite in Soils at Residential and Commercial Properties

Approved by:

Technical Reviewer — Date: 5/10/07

QA Reviewer — Date: 5/10/07

Volpe Center Approval — Date: 05/10/07

EPA Approval — Date: 5/10/07

Section 1
Purpose

EPA will identify and delineate the extent of any visible vermiculite (VV) present in soils as part of all investigations conducted at the Libby Superfund Site and specified in governing guidance documents. The goal of this standard operating procedure (SOP) is to provide a consistent approach to identify and characterize any VV present in soils.

The semi-quantitative approach presented in this SOP for visually estimating VV in soil will be revised as required to optimize data collection as the sampling teams gain experience. This will be accomplished by expanding and/or improving this SOP, supporting pictorial standards, and additional electronic data acquisition efforts, as necessary.

Section 2
Definitions

Specific Use Area (SUA) – Discrete exterior parcels on a property with a designated specific use. Due to the nature of activities typically carried out in SUAs, residents may be especially vulnerable to exposures when Libby amphibole asbestos (LA) contaminated soil becomes airborne. SUAs may be bare or covered with varying amounts of vegetation. SUAs include:

- Flower Pot
- Flowerbed
- Garden
- Stockpile
- Play Area
- Dog Pen
- Driveway (non-paved)
- Parking Lot (non-paved)
- Road (non-paved)
- Alley (non-paved)

Common Use Area (CUA) – Exterior parcels on a property with varied or generic use. CUAs may be bare or covered with varying amounts of vegetation. CUAs include:

- Walkway
- Yard (front, back, side, etc.)
- Former Garden
- Former Flowerbed

Limited Use Area (LUA) – Exterior parcels on a property that are accessed, utilized, and maintained on a very limited basis. LUAs may be bare or covered with varying amounts of vegetation. LUAs include:

- Pasture
- Maintained/Mowed Fields
- Underneath porches/decks[1]
- Overgrown Areas (with trails/footpaths, or between SUAs/CUAs)

Interior Surface Area (ISA) – Interior soil surfaces of buildings such as garages, pumphouses, sheds, and crawlspaces.

Non-Use Area (NUA) – Exterior parcels on a property with no current use (e.g., areas that are un-maintained and not accessed). NUAs may be bare or covered with varying amounts of vegetation. NUAs include:

- Wooded Lots
- Un-maintained Fields

Since NUAs are not currently accessed, they are not presently considered a complete exposure pathway. As such, semi-quantitative visual estimates of vermiculite in soil will not be captured at this time. However, to the extent that NUAs may become a complete exposure pathway in the future, EPA may revisit these NUAs at a later date.

Zone[2] – Parcels on a property that share a similar land use or subdivisions of a land use area based on site conditions (e.g., access, construction setup considerations, etc.) or sampling requirements. No area type may be combined with any other area type. For example, driveways and flowerbeds are both SUAs but will be separated into unique zones for visual inspection. Similarly, large CUAs such as yards may be subdivided into front yard, side yard, and back yard zones dependent on site conditions. Sectioning properties into additional zones will be at the discretion of the field team leader but consistent among the teams.

It is anticipated that SUAs and ISA zones will generally tend to be smaller parcels. Combining small, proximal SUAs into one zone will be at the discretion of the field team leader but consistent among teams. No ISA will be combined with any other ISA for visual inspection. There is not a maximum square footage restriction on any zone.

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[1] The soils underneath porches and decks will be classified as LUAs depending on ground clearance and accessibility to homeowners and pets. If these areas are not accessible, they will be classified as NUAs.
[2] The restriction on the maximum square footage of SUA zones (1,000 ft2) and non-SUA zones (2, 500 ft2) was eliminated from the previous iteration of this SOP after the data were reviewed by EPA and determined to sufficiently characterize the presence of VV regardless of zone square footage. Additionally, this will allow the flexibility necessary for field teams to identify areas of zones most cost effectively for removal purposes.

Point Inspection (PI) – Used in SUA, CUA, LUA, and ISA zones. A PI is an intrusive visual inspection of the top portions of the soil at a randomly selected point within a zone. A PI consists of the active displacement of the surface soil with a small shovel and visual inspection of the displaced soil to determine if VV is present. If VV is observed during the PI, the location and a semi-quantitative estimate of VV contamination will be recorded.

Section 3
Applicability

This SOP applies to properties within the Libby Superfund Site at varying stages of the removal process including, but not limited to, all screening and risk-based investigations, pre-design inspections, and removal actions. Investigation-specific modifications to this SOP are outlined in the governing guidance document for each investigation. The following locations on a property will be evaluated for the presence/absence of VV:

- All parcels on a property where soil samples are being collected.
- All parcels on a property where soil was non-detect for LA during previous sampling activities.
- All SUA parcels on a property that have not been previously characterized as containing VV

Section 4
Procedure

Figure 1 illustrates the procedures and decision rules for this SOP. The three primary procedural steps are listed below:

- Establish zones
- Perform PI
- Perform semi-quantification of visual vermiculite

Each is described in the following subsections.

4.1 Establish Zones

Upon arrival at the property, the field team will locate all areas requiring sample collection (i.e., where previous soil sample results were non-detect for LA or SUAs have not been previously characterized for VV). Parcels will be identified as SUA zones, CUA zones, LUA zones, NUA zones, or ISA zones. The field team will measure the zone sizes and note them on the field sketch and/or design drawings. Zones will be assigned according to the definitions provided above.

4.2 Point Inspections[3]

As defined above, a PI is an intrusive visual inspection performed for the entire surface of a zone. Professional judgment may be used to determine the exact location of PIs; however, the following guidelines will be implemented to maintain consistency.

A minimum of 30 PIs will be evaluated per zone if sampling is required within that zone. If soil sampling is not required, a minimum of 5 PIs will be evaluated within each zone. Zones larger than 500 square feet (ft^2) will require evaluation at a minimum of 1 PI per 100 ft^2 (10 ft by 10 ft area). The PI locations will be randomly selected and will be spatially representative of the entire zone. Locations of the PIs and semi-quantitative estimates of VV (i.e., low, intermediate, or high) will be recorded on the field sketch for each PI. While a minimum of 5 PIs will be conducted per zone, there is no set maximum. Rather, the maximum number of PIs is variable—dependent upon the total area of the zone and achieving the minimum required frequency of 1 PI per 100 ft^2.

The following sections outline procedures for inspecting each use area (e.g., SUA, CUA, LUA, ISA). The procedure for semi-quantification of VV is provided in the next section.

<u>SUA Zone:</u>

- Visually inspect the PI point using a spade or trowel to remove any cover material, including excess debris (e.g., mulch, rock, etc.) and organic material, from the surface of the soil. Remove and visually inspect soil to a depth of 0-6 inches below ground surface[4].
- If a depth of 6 in. cannot be attained given the varying levels of compaction in driveways, roads, etc. the maximum depth attainable will be documented in the field logbook.
- Record semi-quantitative estimate of VV observed as described in the following section.
- Replace soil and cover material.
- Repeat as necessary employing procedure outlined above.

<u>CUA and LUA Zones:</u>

- Visually inspect the PI point using a spade or trowel, carefully removing organic material, including grass, from the surface of the soil. Remove and visually inspect soil to a depth of 0 - 3 inches below ground surface[5].

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[3] Surface Inspections- The non-intrusive visual inspection of the immediate surface of a zone was eliminated from the previous iteration of this SOP after their data were reviewed and determined by EPA to provide no additional information over that gained through Point Inspections.
[4] A soil depth of 6 inches for SUAs was chosen to approximate the depths to which digging would be expected during typical activities occurring in these SUA zones (e.g., gardening, child digging in dirt, etc.)
[5] A soil depth of 0-3 inches was chosen to approximate the depths to which soil disturbance would be most likely during typical activities occurring in these CUA and LUA zones (e.g., lawn mowing, etc.)

- Record semi-quantitative estimate of VV observed as described in the following section.
- Carefully replace all soil and organic material.
- Repeat as necessary employing procedure outlined above.

ISA Zone:

- Move items as necessary to access the soil surface.
- Visually inspect the PI points using a spade or trowel, remove and visually inspect soil to a depth of 0 - 3 inches below ground surface[6].
- Record semi-quantitative estimate of VV observed as described in the following section.
- Repeat as necessary employing procedure outlined above.

If during the PI, VV is observed to be localized within a zone, the portion with vermiculite will be denoted on the field sketch. If additional PIs are necessary to determine the boundaries of the area, approximately 10 to 20% additional PIs will be evaluated to determine the extent of localized vermiculite.

4.3 Semi-Quantification of Visual Vermiculite

During PI, the field team will estimate the quantity of vermiculite observed. Each PI location for all zones will be assigned a semi-quantitative estimate of visible vermiculite content using a 4-point scale: none (blank), low (L), intermediate (M), and high (H)[7]. For PI locations where VV is observed, semi-quantitative estimates (e.g., L, M, or H) will be recorded on the field sketch. PI locations where VV is not observed will not be recorded on the field sketch. Photographs illustrating these quantities are attached to this SOP as Figure 2. Additionally, jars of vermiculite-containing soils representing these three levels will be available for training and reference.

Under the current version of this SOP, there will be no effort to design an approach to combine vermiculite levels for PIs within or among zones. While the viability of combining semi-quantitative visual estimates within or among zones may be assessed as a pilot-scale evaluation, any PI with visible vermiculite qualifies as vermiculite-containing soil for the area represented by the inspection point or inspection zone.

[6] A soil depth of 0-3 inches was chosen to approximate the depths to which soil disturbance would be most likely during typical activities occurring in these IS zones (e.g., entering crawlspace, retrieving items from shed, etc.)

[7] Based on EPA's review of previous data, the 5-level scale VV identification scheme was not meaningful and will be reduced to a 4-level scale. As such the quantity of "Gross" VV in the previous iteration of this SOP was combined with High. Previously collected data of Gross VV should be considered analogous to High VV under this revised SOP.

Section 5
Health & Safety/Engineering Controls

All personnel will carry out visual inspections in accord with proper personal protective equipment (PPE) and other monitoring/governing requirements outlined in the most recent version of the Site Health and Safety Plan governing the work being conducted.

All visual inspections will employ appropriate engineering controls to minimize dust (e.g., wetting soil during inspection) as prescribed in the Site-Specific Standard Operating Procedure for Soil Sample Collection (CDM-LIBBY-05, Revision 2).

Section 6
Equipment Decontamination

Equipment decontamination is not required between each PI from the same zone, but is required before moving to another inspection zone. Decontamination of equipment will be conducted as required by the governing guidance documents.

Section 7
Documentation

As noted above, information about the presence of vermiculite will be recorded on the field sketch or design drawing for the property under investigation. Each zone will be marked with:

- Zone type (i.e., SUA, CUA, LUA, NUA, or ISA)
- Zone area in ft^2
- PI locations/points
- Semi-quantitative estimate of VV content for each PI (i.e., L, M, H)

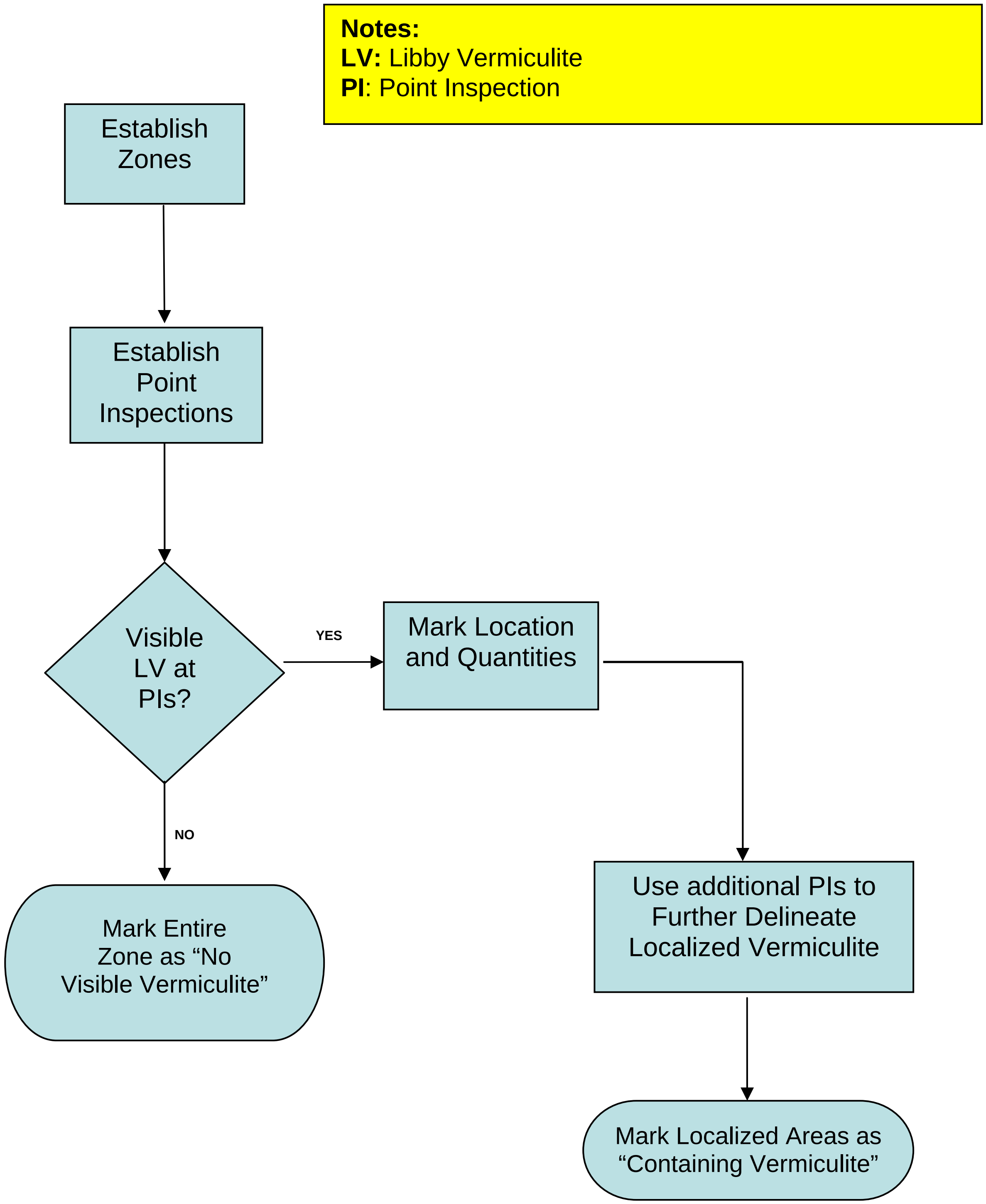
In addition to field sketch/design drawing documentation, each field team will generate a Visual Vermiculite Estimation Form (VVEF) (Figure 3) to document the semi-quantitative visual estimates of VV for each PI for possible future information use. This form will be managed according to governing guidance documents.

Section 8
Training

Every effort will be made to ensure consistency in the semi-quantitative evaluation of VV in soil to the extent possible. This will include training (e.g., field calibration), specimen examples (i.e., jars/photographs of low, intermediate, and high quantities of vermiculite, etc.), designated field staff, and oversight by the field team leader. Figures illustrating none, low, intermediate, and high quantities of vermiculite are attached to this SOP for reference (Figure 2).

To ensure consistency over time, the field team leader will verify semi-quantitative assignments at a rate of one property per team per week. The field team leader will sign off on those field sketches that were verified. If inconsistencies are noted, the field team leader will hold re-training with all teams participating simultaneously. Updates to the SOP and its attached specimen examples will occur as necessary and the EPA Project Team Leader and Technical Assistance Unit will be notified when these updates are recommended by the field team leader or field investigation manager.

Figure 1 – Visible Vermiculite Inspection Process



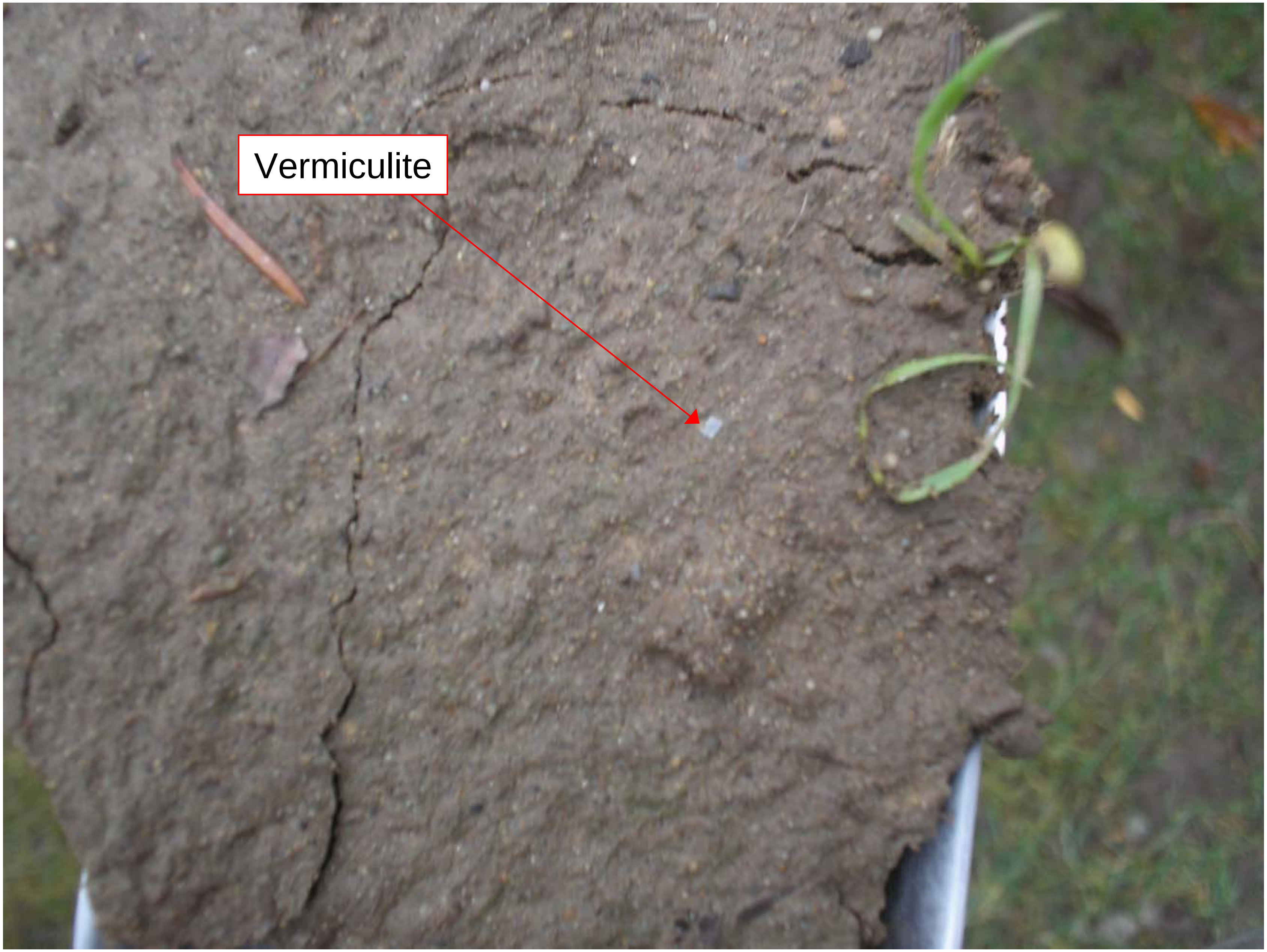


Figure 2a: Low Visible Vermiculite – A maximum of a few flakes of vermiculite observed within a given visual inspection point

Figure 2b: Intermediate Visible Vermiculite – Vermiculite easily observed throughout visual inspection point, including the surface.

Figure 2c: Intermediate Visible Vermiculite – Vermiculite easily observed throughout visual inspection point, including the surface.

Figure 2d: High Visible Vermiculite – Vermiculite easily observed throughout visual inspection point, including the surface.

LIBBY SUPERFUND SITE
Visual Vermiculite Estimation Form (VVEF)

Field Logbook No.: ____________ Page No.: ____________ Site Visit Date: ____________ BD Number: ____________
Address: ____________ Structure Description: Property
Occupant: ____________ Phone No.: ____________
Owner (If different than occupant): ____________ Phone No.: ____________
Investigation Team: ____________ Investigation Name: ____________
Field Form Check Completed by (100% of Forms): ____________ Visual Verification by Field Team Leader (10% of forms): ____________

		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Type (SUA/CUA/LUA/IS)									
Description									
Area Size (square feet)									
General Comment (Cover, etc.)									
PIs (X=None, L=Low, M=Intermediate, H=High)	**X**								
	L								
	M								
	H								
	Total	0	0	0	0	0	0	0	0

Areas previously identified for removal not inspected for visible vermiculite? **Yes** **No** **NA** **Location(s):** ____________

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